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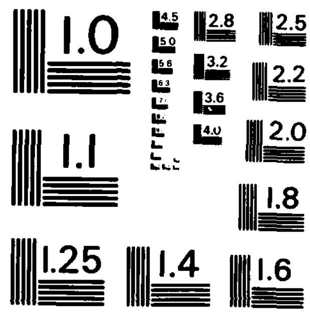

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TRAINING TECHNOLOGY HANDBOOK FOR SYSTEM ACQUISITION PLANNERS: PRELIMINARY VERSION

NAVY PERSONNEL RESEARCH AND DEVELOPMENT CENTER
SAN DIEGO, CALIFORNIA

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TRAINING TECHNOLOGY HANDBOOK FOR SYSTEM ACQUISITION PLANNERS: PRELIMINARY VERSION

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FOREWORD

This effort was conducted under contract N00123-78-C-0748 by the Honeywell Systems and Research Center and the Calspan Advanced Technology Center in support of Navy Decision Coordinating Paper Z0109-PN, subproject Z0109-PN.03 (Manpower Cost in System Design). It was sponsored by the Deputy Chief of Naval Operations (Manpower, Personnel, and Training, OP-01). The objective of the subproject is to develop information and techniques to assist hardware developers in assessing the people-related implications of their designs and in conducting manpower cost-effectiveness trade-off studies during the design process.

The objective of this effort was to generate the data for and develop a preliminary training technology handbook. The final form of this handbook is intended to assist hardware acquisition managers, training program developers, and others in estimating the composition and cost of training required for new weapon system acquisitions.

This report is being released at this time as a working draft to provide for distribution to the research community. Further development will be required before the handbook is ready for broad application within the hardware acquisition community. The NPRDC contract monitor for this initial effort was Mr. Ernest A. Koehler.

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SECTION I

INTRODUCTION

INTENDED USERS OF THE HANDBOOK

This handbook is intended for the following:

- Acquisition managers--Chief of Navy Material-designated project managers; or program, system, equipment, or component managers
- Design engineers--personnel responsible for developing and evaluating weapon system design concepts and models
- Training managers--office of the Deputy Chief of Naval Operations for Manpower, Personnel, and Training, integrated logistic support managers, and personnel and training analysis offices
- The R&D community--project managers, research and development centers and laboratories, and the Naval Sea Systems Command

OBJECTIVE OF THE HANDBOOK

The handbook is intended to provide tools which allow planners to make estimates of the composition and cost of training required for new weapon systems.

RATIONALE FOR THE HANDBOOK

The handbook was developed for the following reasons:

- Recent DoD directives (5000.1 and 5000.2) require that new weapon systems be developed in an integrated fashion; subsystems should be developed concurrently as part of the total system. Special attention should be given to points at which various subsystems (e.g., hardware configuration and manpower) interact, and early trade-off decisions should be made.
- The requirements for coordinated development of subsystems and early trade-off analyses are intended to assist in reducing the life-cycle costs of weapon systems. It is estimated that over half of the life-cycle costs of weapon systems is attributable to personnel and training resources. These areas must be emphasized in the early phases of the weapon system acquisition process (WSAP).
- In the past, it has been difficult to integrate consideration of training requirements into early phases of the WSAP for the following reasons:

  -lack of readily-accessible cost and resource data from which estimates could be derived

  -inability to specify major cost-driver training resources such as instructor, facility, and equipment requirements

  -failure to anticipate long lead times required for planning, programming, and budgeting certain training resources such as new buildings.

USE OF THE HANDBOOK WITHIN THE WSAP

The WSAP is defined by five phases:

- Preconcept

  -identification of operational needs

  -consideration of technological solutions
- Conceptual

  -analysis of the threat, mission, feasibility of alternative solutions, risk, and cost and performance trade-offs

- definition of alternative conceptual systems
- experimental tests of operational requirements, key components, critical subsystems, and marginal technology

- Validation
  - advanced development prototypes
  - hardware development and evaluation
  - resolution of major issues and risks
  - validation of program characteristics
- Full-Scale Engineering Development (FSED)
  - design, fabrication, and test of the weapon system, including all support elements (training, maintenance, handbooks, etc.)
  - demonstrated operational performance and reliability of the weapon system
  - documentation necessary to produce systems for operational use
- Production/Deployment
  - production of the weapon system and all support elements
  - distribution and use of the system by fleet operational units

As the weapon system proceeds through these five phases of the WSAP, the handbook is intended primarily to help the reader estimate training resource requirements and costs during the preconcept and conceptual phases.

Figure 1 illustrates the extent to which this handbook is to be relied upon to estimate training resources and costs during the phases of the WSAP. The figure also indicates the use of other information (e.g., new weapon system technical data) on which to base these estimates.

Use of the handbook is most beneficial during the early part of the WSAP. In early phases, few details about the new weapon-system hardware are available. In the absence of these details, the handbook provides information on which to base training resource requirement decisions. Later, when data on the developing system hardware become available, adjusted estimates of resource requirements should be made, based on this additional information.

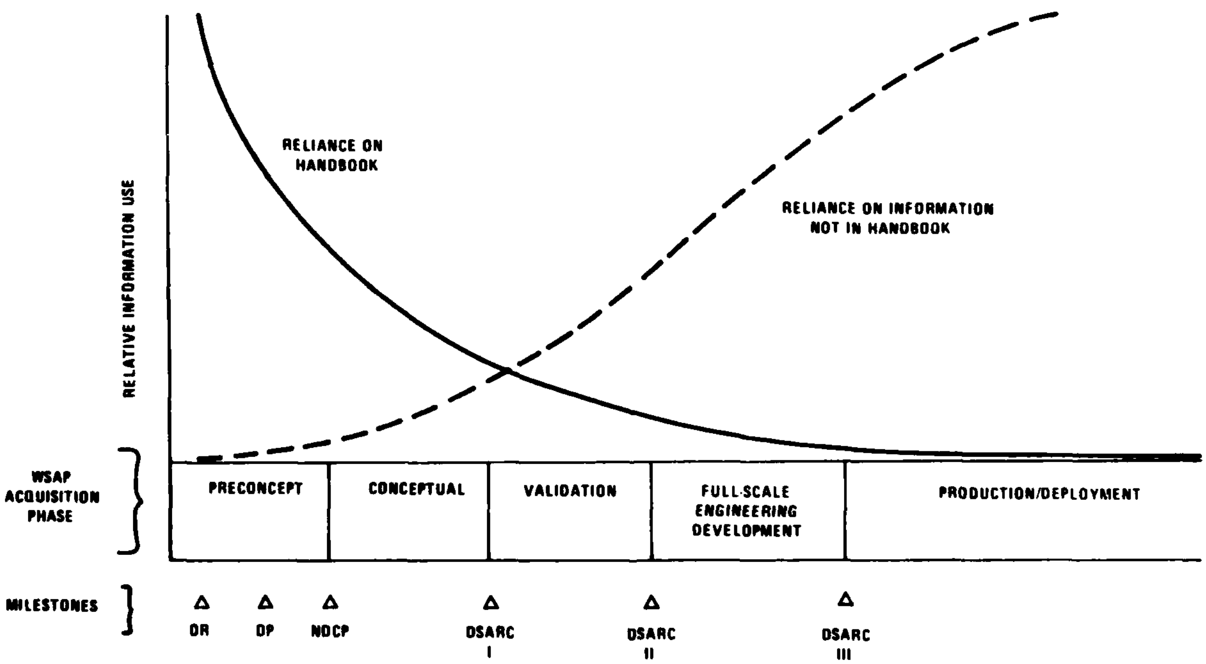


Figure 1. Use of the Handbook Within the WSAP

L POINTS IN THE WSAP WHERE
G DECISIONS MUST BE MADE*

requirements are identified and revised through-fe cycle of the weapon system. As the system , matures, and is put into operation, changes in · configuration, maintenance philosophy, mission on, and skill levels of personnel using the system ite continuous evaluation and revision of the train-rstem. The rate at which these changes occur nagnitude of these changes are greatest in the ·t of the WSAP.

ular, major training resource requirements identified in the preconcept and conceptual phases ;AP. Key planning documents which should state requirements are:

Operational Requirement (OR). ORs are brief statements of operational needs or requirements and may be submitted by any fleet activity or Navy command via the chain of command to the cognizant CNO Resource and Mission Sponsor with a copy to DRDT&E for entry into the Navy development and acquisition selection process.

- Development Proposal (DP). The DP formally responds to the OR. The DP will be submitted in accordance with the schedule and special instructions (e.g., reliability and maintainability, manpower and software requirements, etc.) contained in the promulgating letter forwarding the OR. It is anticipated that an iterative process will be developed through an informal dialogue between the OPNAV OR sponsor and the CNM to prepare the DP. In the process, CNM should consult with DT&E activities and COMOPTEVFOR (for OT&E) while preparing the initial draft to ensure that adequate scheduling and resource allocation are provided for T&E. In this manner, all questions in relation to the statement of the requirement (OR) and the development of alternatives available to

in this section was taken from Moore, 1977, NST 5000.42A, and OPNAVINST 5000.46.

fulfill the requirement (DP) are resolved in the NDCP, including T&E, manpower, personnel, and training requirements. The DP is subsumed by an approved NDCP, DCP, or PM.

- Navy Decision Coordinating Paper (NDCP). The NDCP document defines program issues, the considerations which support the operational need, program objectives, program plans, performance parameters, areas of risk, development alternatives, level of logistic support, and relationship to logistic capabilities. The NDCP marks the beginning of the Concept Phase of system development.

- Decision Coordinating Paper (DCP). The DCP is a decision document, not more than 20 pages long, designed to provide the DEPSECDEF and his DSARC principals essential program information. The DCP supports the decision-making process and establishes an agreed commitment for major programs.

he OR should contain:

- Consideration of manpower costs
- Feasibility of providing personnel with the necessary skills to operate and maintain the new system
- Allowance for trade-offs to minimize manpower (including training) costs

The DP should contain:

- Description of alternative logistic support approaches and their impact on personnel skill levels and numbers
- Description of training requirements and their impact upon introduction of the new system

The NDCP should contain:

- Manning estimates in terms of numbers of personnel, skills, and life-cycle costs
- Estimates of training requirements, description of existing courses, equipment, devices, and instructors
- Description of critical skills unique to the new system and not currently in the Navy inventory

The DCP is used to support a decision by the Secretary of Defense to enter each of the subsequent phases of the WSAP. A DCP is associated with each of the Defense Systems Acquisition Review Council (DSARC) milestones indicated in Figure 1. Table 1 presents the kinds of questions raised at each of the DSARC milestones.

ORGANIZATION OF THE HANDBOOK

As indicated in Figure 2, there are three major sections to the handbook; each section is divided into two or more subsections:

A. Specification of training requirements: existing systems
   - Identify similar existing system
   - Determine requirements and costs for existing system

B. Specification of training requirements for special tasks that would require hands-on training resources, such as training equipment or devices
   - Examine tasks typically performed to identify new task requirements
   - Determine hands-on training tasks
   - Determine training device requirements
   - Contact CNET

C. Translation of quantitative resource requirements
   - Compare existing and new system data
   - Determine total manning requirements
   - Estimate new system student throughput
   - Derive new system total training requirements

At the beginning of each section is a table to indicate the questions to be answered, reasons for questions, how to answer questions, and the nature of the answer to each question.

At the end of each section an example is given, indicating how the section should be used.

TABLE 1. KINDS OF QUESTIONS RAISED AT DSARCs

DSARC I	DSARC II	DSARC III
• What are the broad training objectives (including operator, maintenance, team, and other training)? • What are the course lengths? • Where are the proposed training sites located? • Is adequate space available for training? • Is there a need for military construction? • How many instructors and support personnel are required? • What student/instructor ratios will be maintained? Why? • What is the average on-board number of students? • What quantity of training equipment is needed? • Are training devices required? If so, what characteristics are required and how many are needed? • How will training equipment and devices be supported? • What other training materials (e.g., audio-visual) are required • What RDT&E support is required for development of training material?	• Have the previously identified requirements been evaluated, revised, and validated? • Have alternative training strategies been evaluated with respect to their impact on weapon system design? • Has programming allowed for required lead times (OPNAVINST 1500.8J)? -6 yrs. for training devices 4 yrs. for military construction -3 yrs. for billets • Have resources been programmed for initial training? Have contracts been let? • Have training resource requirements been defined for follow-on/replacement training? • Has planning begun for OPEVAL?	• Have resources been programmed for follow-on/replacement training? • Have training materials been reviewed by CNET functional commands? • Has the Navy Training Plan (NTP) been revised as necessary? • Have request for proposal (RFP), contract schedule, specifications, and proposal evaluation criteria been developed for follow-on/replacement training?

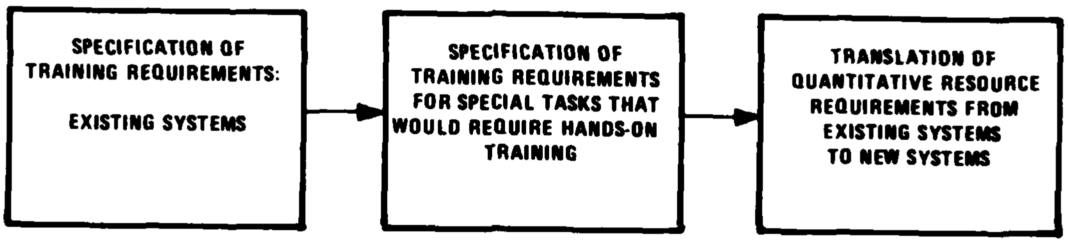


Figure 2. Overview of the Handbook

SECTION II

SPECIFICATION OF TRAINING REQUIREMENTS: EXISTING SYSTEMS

Figure 3 illustrates the contextual and procedural flow of this section.

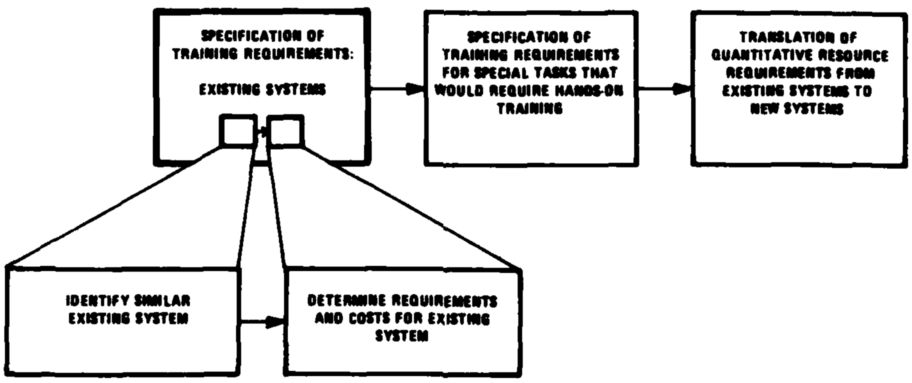


Figure 3. Context and Procedures in Section II

REASON FOR THIS SECTION

Major cost-driver training resource requirements must be identified early in the WSAP to allow for planning, programming, and budgeting. However, the data necessary to derive estimates of training resource requirements for the new system may not be available during the early stages of the WSAP.

Because of data limitations, data from a similar existing system may be used to base initial estimates of training requirements for the new system. Through a comparison of the new system to a similar system already in existence, ballpark estimates can be obtained for training requirements such as:

- Manning authorization
- Length of training program
- Major training areas
- Student throughput
- Instructor demands
- Facility demands
- Equipment demands
- Software demands
- Schedule
- Major training cost-drivers
- Total training cost
- Total training cost break out

Table 2 presents questions to be answered in this section, reasons for answering each question, an indication of how each question is to be answered, and the nature of the answer to each.

WHAT IS TO BE DONE IN THIS SECTION

First, identify similar, existing hardware systems. Second, determine training resource requirements and costs for this existing system.

Identify similar existing system	→	Determine requirements and costs for existing system

TABLE 2. QUESTIONS TO BE ANSWERED IN SECTION II

Question	Reason for Question	How to Answer Question	Output
What system, already in existence, is similar to the new system to be developed?	Necessary data on the new system may not be available, therefore, initial estimates may be based on similar, existing system data.	From the alternatives given in Tables 4-28, identify which system is most similar to the new system. The checklist in Table 3 is an aid to this process.	Identification of a similar existing system
What are the training resource requirements and costs of a similar existing system?	Training resource data of a similar existing system provide a basis for initial requirements and cost estimates for the new system.	Examine existing system's training resource and cost data presented in Tables 4-28.	Determination of training requirements and costs for a similar existing system

HOW THIS IS TO BE DONE

STEP 1

- Identify whether the new system is a data system, fire control system, electronic system, sonar system, or communication system.
- Refer to the appropriate system section of Tables 4-28 (data system, fire control system, etc.)
- Identify which of the five existing systems listed under the appropriate system section is most similar to the new system.

Based on a general knowledge of the existing systems contained in Tables 4-28, select the two or three most likely similar to the new system (the system under development).

Systematically compare the new system with each of the candidate similar existing systems. Criteria for judging system similarity should include system

characteristics which relate to training resource requirements. In addition, some criteria may be more appropriate for use in comparing some types of systems but not others. Table 3 and the procedures for using the table are intended as an aid to the reader in comparing systems. Based upon a detailed understanding of the systems being examined and a consideration of the appropriateness of the criteria in Table 3 for those system types, the reader may wish to tailor the use of Table 3 as necessary.

Table 3 contains a list of 30 design concepts and characteristics. (These concepts and characteristics are defined in the Appendix.) Next to this list are columns labeled "new (N)," "existing (E)," and "common (C)."

Begin by considering which of the design concepts or characteristics are planned for or likely to be included in the new system. Place a check mark under the "new (N)" column next to each concept or characteristic in the new system.

Next consider which design concepts or characteristics are included in a candidate existing system. Place a check mark under the "existing (E)" heading next to each design concept or characteristic included in the existing system under analysis.

Then compare the check marks under the "new (N)" and "existing (E)" columns. Each time a check appears in both columns for a given design concept, place a check in the "common (C)" column to indicate that the concept is common to both the new and existing system under comparison.

Count the number of checks in the "new (N)" column and write the total at the bottom in the box marked "Total Ns." Similarly, count the checks in the "existing (E)" and "common (C)" columns and write their totals in the "Total Es" and "Total Cs" boxes.

Finally, compute an index of similarity (S) by placing the three totals in the following formula:

$$S = \frac{\text{Total Cs}}{(\text{Total Ns}) + (\text{Total Es}) - (\text{Total Cs})}$$

Repeat the above procedure for each candidate existing system to be compared with the new system.

Unless there are other overriding considerations, the candidate similar system with the largest index of similarity (S) should be selected as the existing system most similar to the new system.

TABLE 3. CHECKLIST FOR COMPARING SIMILARITY OF NEW AND EXISTING SYSTEMS

Name of Existing System Being Compared ______________________

Design Concepts and Characteristics	New (N)	Existing (E)	Common (C)
1. Repair of Modules			
2. Throwaway Modules			
3. Automatic Performance Monitoring			
4. Built-In Test Equipment (BITE)			
5. Built-In Troubleshooting Logic Aids			
6. Automatic Fault Localization			
7. Manual Troubleshooting			
8. Standard Hardware (Component, Card, Functional Unit)			
9. Standard Hardware (Subsystem)			
10. Built-In Operator Job Aids			
11. Automatic Decision Making			
12. Automation Information Transmit and Display			
13. Built-In (Embedded) Training			
14. Combined Operator/Maintainer Functions			
15. Multipurpose Equipment			
16. Single Purpose Equipment			
17. Manual Control			
18. Automatic Control			
19. Quantitative Controls/Displays			
20. Go/No Go Controls/Displays			
21. Dynamic Interaction of Controls/Displays			
22. Independence of Controls/Displays			
23. Fixed Sequence of Operation			
24. Nonprocedural Operational Flexibility			
25. Troubleshoot to Component Level			
26. Troubleshoot to Module Level			
27. Special Purpose Test Equipment			
28. General Purpose Test Equipment			
29. On-Site Maintenance & Calibration			
30. Off-Site Maintenance & Calibration			
$S = \frac{(\text{Total Cs})}{(\text{Total Ns}) + (\text{Total Es}) + (\text{Total Cs})}$	Total Ns	Total Es	Total Cs
$S = \frac{(\quad)}{(\quad) + (\quad) + (\quad)} =$			

Name of Existing System Being Compared ______________________

Design Concepts and Characteristics	New (N)	Existing (E)	Common (C)
1. Repair of Modules			
2. Throwaway Modules			
3. Automatic Performance Monitoring			
4. Built-In Test Equipment (BITE)			
5. Built-In Troubleshooting Logic Aids			
6. Automatic Fault Localization			
7. Manual Troubleshooting			
8. Standard Hardware (Component, Card, Functional Unit)			
9. Standard Hardware (Subsystem)			
10. Built-In Operator Job Aids			
11. Automatic Decision Making			
12. Automation Information Transmit and Display			
13. Built-In (Embedded) Training			
14. Combined Operator/Maintainer Functions			
15. Multipurpose Equipment			
16. Single Purpose Equipment			
17. Manual Control			
18. Automatic Control			
19. Quantitative Controls/Displays			
20. Go/No Go Controls/Displays			
21. Dynamic Interaction of Controls/Displays			
22. Independence of Controls/Displays			
23. Fixed Sequence of Operation			
24. Nonprocedural Operational Flexibility			
25. Troubleshoot to Component Level			
26. Troubleshoot to Module Level			
27. Special Purpose Test Equipment			
28. General Purpose Test Equipment			
29. On-Site Maintenance & Calibration			
30. Off-Site Maintenance & Calibration			
$S = \frac{(\text{Total Cs})}{(\text{Total Ns}) + (\text{Total Es}) + (\text{Total Cs})}$	Total Ns	Total Es	Total Cs
$S = \frac{(\quad)}{(\quad) + (\quad) + (\quad)} =$			

Once this system has been identified, training resource and cost information can be obtained by examining the appropriate data table (Tables 4-28).

STEP 2

- Obtain training resource and cost information for the similar existing system by examining the table data.

EXAMPLE OF HOW THIS SECTION SHOULD BE FOLLOWED

STEP 1

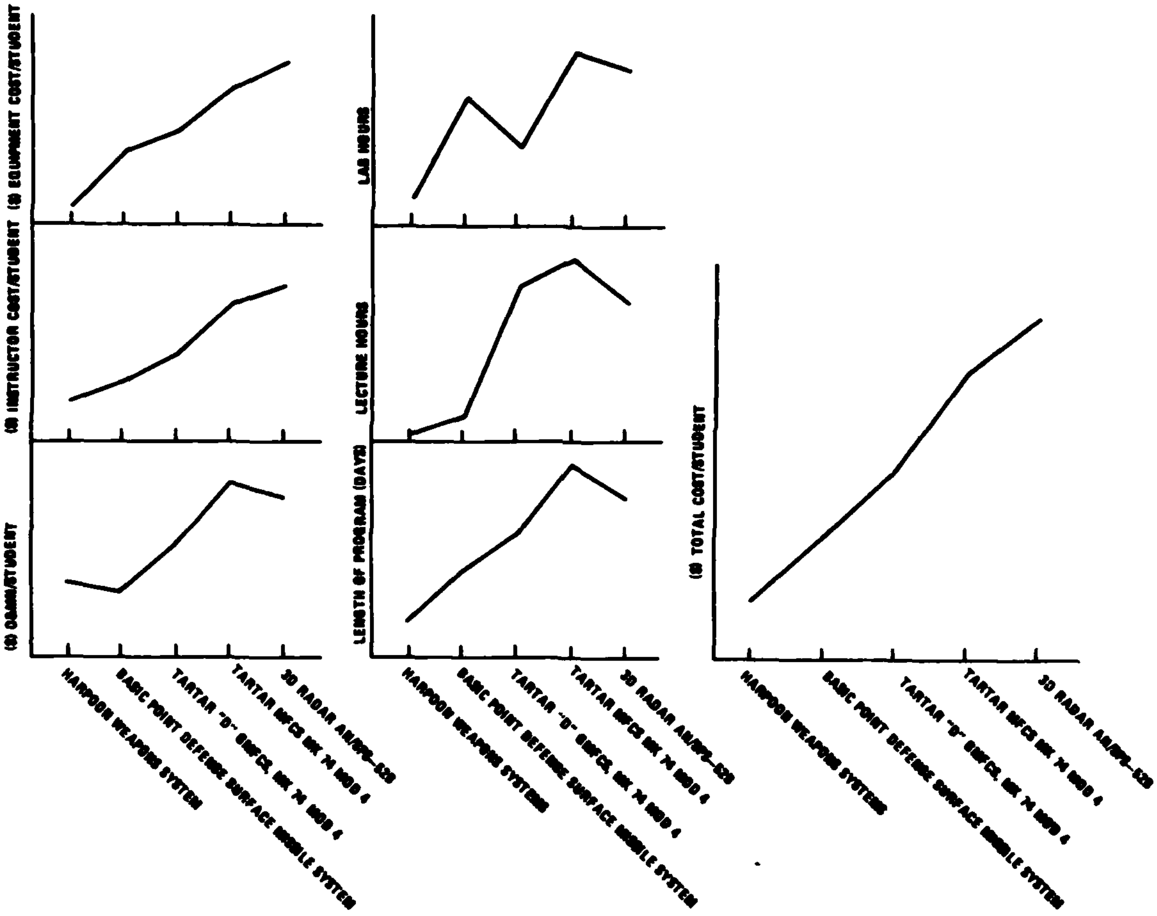
Identify what rating is associated with the new system.

- Assume the new system is an AN/SPS-53 radar for fire control systems.
- The user would locate the fire control system section of Tables 4-28 (i.e., Tables 4-8).

Identify the most similar existing system.

- Based on a general knowledge of the existing fire control systems contained in Tables 4-8, the user would select two candidate existing systems most likely similar to the new system (e.g., AN/SPS-52B, TARTAR MK 74 MOD 4).
- Using Table 3, the user would consider which design concepts or characteristics are likely to be included in the new system. Table 29 illustrates the use of Table 3. The user would place a check mark under the "new (N)" column next to each concept or characteristic in the new system. For the sake of this example, suppose this resulted in check marks being placed in rows 1, 3, 4, 5, 6, 8, 9, 10, 12, 18, 19, 23, and 27 of the "new (N)" column of Table 3 (see Table 29). Note that the reader may wish to tailor the use of Table 3 as necessary, based upon a detailed understanding of the systems being examined and a consideration of the appropriateness of the criteria in Table 3, for the system types being considered.
- Next, the user would determine which design concepts or characteristics are included in the first candidate existing system (e.g., AN/SPS-52B). The user would place a check mark under the "existing (E)" column next to each

(Text continued on p. 68)



GRAPHICAL PRESENTATION OF TRAINING TIME AND COST REQUIREMENTS FOR THE FIVE <u>EXISTING FIRE CONTROL SYSTEMS</u> REPRESENTED ON THE FOLLOWING PAGES. THESE FACTORS ARE RELATED TO SYSTEM COMPLEXITY.

DATA CATEGORIES

NEC--Primary Navy Enlisted Classification associated with the system

Student Throughput (Per Year)--Average number of students graduated each year

Length of Program (Days)--Average time required to complete the course

Schedule (Per Year)--Average number of courses completed each year

Major Training Areas (Hours)--Total number of lecture and laboratory hours required (50 minute periods)

Number of Operational Units--Total number of units presently in the field

Manning Authorization--Total number of personnel assigned to each operational unit

Instructor Demands--Estimate of the number of instructors required. To account for variations in course scheduling and student/instructor ratios, this estimate reflects a midpoint between the minimum and maximum number of instructors necessary for training.

Facility Demands--Building construction, modification or space required to adequately house training equipment, etc.

Equipment Demands--Amount and type of hardware or test equipment required for training

Software Demands--Qualitative description of any special software needs

Major Cost Drivers--Qualitative description of salient operating cost factors

Equipment Costs (Per Student $)--Cost of training equipment and devices computed per student. This figure is based on a 10 year life span, 10% salvage value, straight line depreciation schedule for all items over $1,000.

Instructor Costs (Per Student $)--Cost of instructors computed per student. This figure represents pay of all military and travel costs.

O&MN (Per Student $)--Operations and Maintenance, Navy costs for each student. O&MN costs are administrative and overhead costs indirectly involved in training, such as support and organizational personnel, facility operations, maintenance and security, etc.

Total Training Cost (Per Student $)--Total cost for one student to complete the training course

TABLE 4.
HARPOON WEAPONS SYSTEM

NEC	FT-1111
STUDENT THROUGHPUT (PER YEAR)	29
LENGTH OF PROGRAM (DAYS)	48
SCHEDULE (PER YEAR)	6.4
MAJOR TRAINING AREAS (HOURS)	118 LECTURES 82 LABS

NUMB" OF OPERATIONAL UNITS	46
MANNING AUTHORIZATION	5

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	2		AN/SWG-1(V) 1 (FOR OPERATORS, THERE IS A 4 STATION OPERATOR TRAINER)	TRAINER SOFTWARE
MAJOR COST DRIVERS				
COST BREAKOUT (PER STUDENT $)	1000	733*	500	300
O&MN (PER STUDENT $)		1063		
TOTAL TRAINING COST (PER STUDENT $)		5230		

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

E 5.
: POINT DEFENSE SURFACE MISSILE SYSTEM

NEC	FT-1146
STUDENT THROUGHPUT (PER YEAR)	48
LENGTH OF PROGRAM (DAYS)	96
SCHEDULE (PER YEAR)	2.0
MAJOR TRAINING AREAS (HOURS)	161 LECTURES 363 LABS

BER OF OPERATIONAL UNITS	31
NING AUTHORIZATION	2

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
SANDS	4		2 BPD SMS (1 AT EACH OF 2 LOCATIONS) NO TRAINING DEVICES REQUIRED	
IOR COST DRIVERS				
T BREAKOUT (PER STUDENT $)	2500	1573*	4681	
NN (PER STUDENT $)			1578	
TAL TRAINING COST R STUDENT $)			$\boxed{11,236}$	

*THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

TABLE 6.
TARTAR "D" GMFCS, MK 74 MOD 4

NEC	FT-1154
STUDENT THROUGHPUT (PER YEAR)	1
LENGTH OF PROGRAM (DAYS)	138
SCHEDULE (PER YEAR)	8.3
MAJOR TRAINING AREAS (HOURS)	537 LECTURES 221 LABS

NUMBER OF OPERATIONAL UNITS	2
MANNING AUTHORIZATION	3

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS MAJOR COST DRIVERS	1	NO NEW BUILDINGS OR REHAB IS REQUIRED	1 MK 74 MOD 4	SIMULATION. SOFTWARE
COST BREAKOUT (PER STUDENT $)	3724	NONE	8487	3000
O&MN (PER STUDENT $)	2476			
TOTAL TRAINING COST (PER STUDENT $)	17,030			

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TABLE 7.
TARTAR MFCS MK 74 MOD 4

NEC	FT-1160
STUDENT THROUGHPUT (PER YEAR)	28
LENGTH OF PROGRAM (DAYS)	215
SCHEDULE (PER YEAR)	1.4
MAJOR TRAINING AREAS (HOURS)	806 LECTURES 406 LABS

NUMBER OF OPERATIONAL UNITS	2
MANNING AUTHORIZATION	11

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	6	NO NEW BUILDINGS OR REHAB IS REQUIRED	1 MK 74 MOD 4	SIMULATION SOFTWARE
MAJOR COST DRIVERS				
COST BREAKOUT (PER STUDENT $)	5772	NONE	10,066	NONE
O&MN (PER STUDENT $)			3838	
TOTAL TRAINING COST (PER STUDENT $)			20,307	

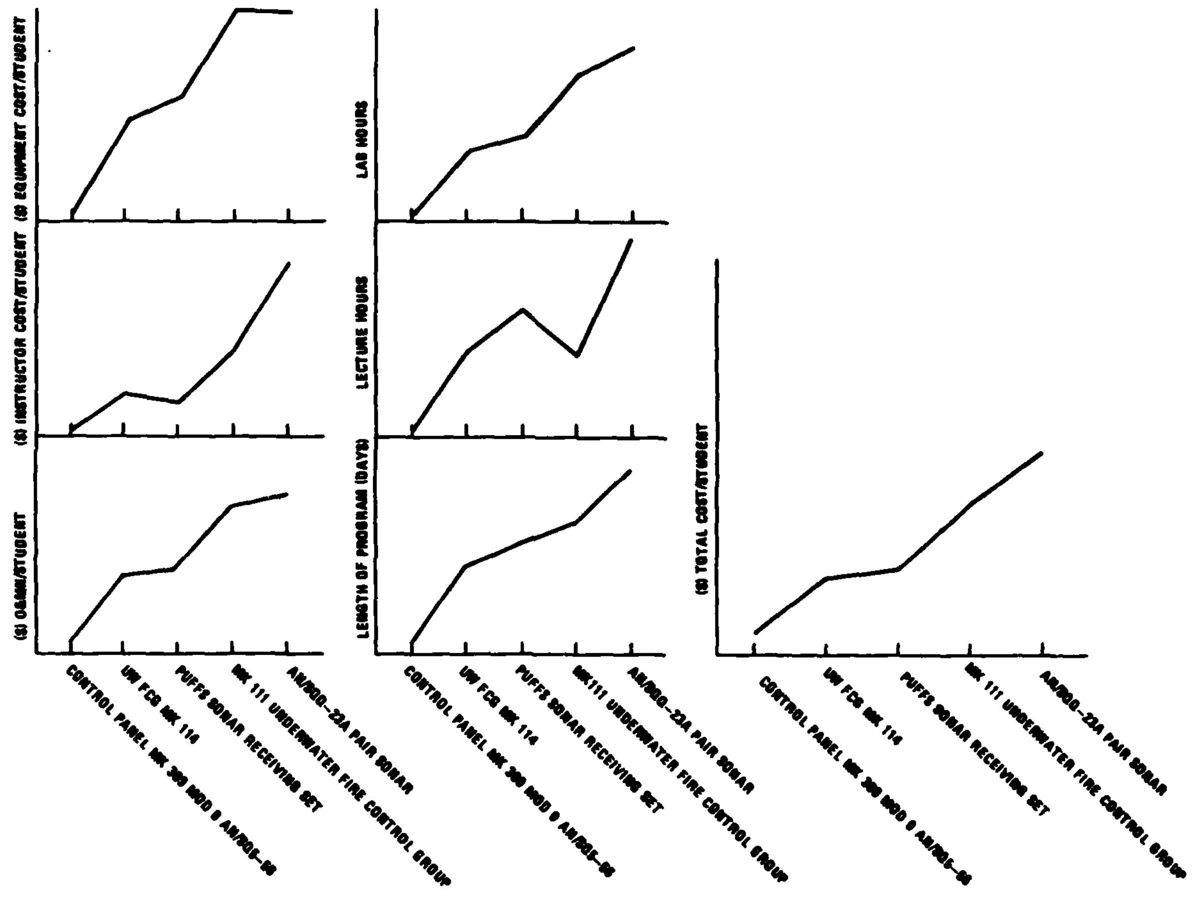
TABLE 8.
3D RADAR AN/SPS – 52B

NEC	FT–1137
STUDENT THROUGHPUT (PER YEAR)	23
LENGTH OF PROGRAM (DAYS)	177
SCHEDULE (PER YEAR)	1.77
MAJOR TRAINING AREAS (HOURS)	481 LECTURES 444 LABS

NUMBER OF OPERATIONAL UNITS	38
MANNING AUTHORIZATION	4

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	5	NEW CONSTRUCTION FOR INSTALLATION OF 2 UNITS	ONE SPS 52B FOR EACH OF 2 LOCATIONS OPERATOR TRAINER	TRAINER SOFTWARE
MAJOR COSTS DRIVERS				
COST BREAKOUT (PER STUDENT $)	8543	4280*	12,829	3000
O&MN (PER STUDENT $)		3386		
TOTAL TRAINING COST (PER STUDENT $)		30,975		

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.



GRAPHICAL PRESENTATION OF TRAINING TIME AND COST REQUIREMENTS FOR THE FIVE EXISTING SONAR SYSTEMS REPRESENTED ON THE FOLLOWING PAGES. THESE FACTORS ARE RELATED TO SYSTEM COMPLEXITY.

DATA CATEGORIES

NEC--Primary Navy Enlisted Classification associated with the system

Student Throughput (Per Year)--Average number of students graduated each year

Length of Program (Days)--Average time required to complete the course

Schedule (Per Year)--Average number of courses completed each year

Major Training Areas (Hours)--Total number of lecture and laboratory hours required (50 minute periods)

Number of Operational Units--Total number of units presently in the field

Manning Authorization--Total number of personnel assigned to each operational unit

Instructor Demands--Estimate of the number of instructors required. To account for variations in course scheduling and student/instructor ratios, this estimate reflects a midpoint between the minimum and maximum number of instructors necessary for training.

Facility Demands--Building construction, modification or space required to adequately house training equipment, etc.

Equipment Demands--Amount and type of hardware or test equipment required for training

Software Demands--Qualitative description of any special software needs

Major Cost Drivers--Qualitative description of salient operating cost factors

Equipment Costs (Per Student $)--Cost of training equipment and devices computed per student. This figure is based on a 10 year life span, 10% salvage value, straight line depreciation schedule for all items over $1,000.

Instructor Costs (Per Student $)--Cost of instructors computed per student. This figure represents pay of all military and travel costs.

O&MN (Per Student $)--Operations and Maintenance, Navy costs for each student. O&MN costs are administrative and overhead costs indirectly involved in training, such as support and organizational personnel, facility operations, maintenance and security, etc.

Total Training Cost (Per Student $)--Total cost for one student to complete the training course

TABLE 9.
CONTROL PANEL MK 309 MOD 0 AN/SQ5–56

NEC	ST–0478
STUDENT THROUGHPUT (PER YEAR)	34
LENGTH OF PROGRAM (DAYS)	12
SCHEDULE (PER YEAR)	30.9
MAJOR TRAINING AREAS (HOURS)	37 LECTURES 43 LABS

NUMBER OF OPERATIONAL UNITS	44
MANNING AUTHORIZATION	5

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	1	400 ft^2	(2) MK 309	
MAJOR COST DRIVERS			SPARE PARTS	
COST BREAKOUT (PER STUDENT $)	354	95*	180	
O&MN (PER STUDENT $)			182	
TOTAL TRAINING COST (PER STUDENT $)			1116	

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

TABLE 10.
UW FCG MK 114

NEC	ST-0434
STUDENT THROUGHPUT (PER YEAR)	106
LENGTH OF PROGRAM (DAYS)	98
SCHEDULE (PER YEAR)	4.1
MAJOR TRAINING AREAS (HOURS)	272 LECTURES 288 LABS

NUMBER OF OPERATIONAL UNITS	120
MANNING AUTHORIZATION	4

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	5	1200 ft^2 LAB 1725 ft^2 CLASS	(4) MK 114	
MAJOR COST DRIVERS			SPARE PARTS	
COST BREAKOUT (PER STUDENT $)	2300	425*	1431	
O&MN (PER STUDENT $)		1100		
TOTAL TRAINING COST (PER STUDENT $)		[illegible]		

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

TABLE 11.
AN/BQG-4/4A PUFFS SONAR RECEIVING SET

NEC	ST-[illegible]
STUDENT THROUGHPUT (PER YEAR)	7
LENGTH OF PROGRAM (DAYS)	124
SCHEDULE (PER YEAR)	1.6
MAJOR TRAINING AREAS (HOURS)	386 LECTURES 334 LABS

NUMBER OF OPERATIONAL UNITS	7
MANNING AUTHORIZATION	2

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	1	330 ft^2	AN/BQG-4 FC NO. 3 CABINET	
MAJOR COST DRIVERS			SPARE PARTS	
COST BREAKOUT (PER STUDENT $)	1930	400*	1700	
O&MN (PER STUDENT $)			1225	
TOTAL TRAINING COST (PER STUDENT $)			9187	

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

TABLE 12.
MK 111 UNDERWATER FIRE CONTROL GROUP

NEC	ST-0431
STUDENT THROUGHPUT (PER YEAR)	7
LENGTH OF PROGRAM (DAYS)	146
SCHEDULE (PER YEAR)	1.4
MAJOR TRAINING AREAS (HOURS)	258 LECTURES 582 LABS

NUMBER OF OPERATIONAL UNITS	32
MANNING AUTHORIZATION	4

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	4	300 ft² LAB 1300 ft² CLASS	MK 111	
MAJOR COST DRIVERS			SPARE PARTS	
COST BREAKOUT (PER STUDENT $)	4631	837*	2081	
O&MN (PER STUDENT $)		2904		
TOTAL TRAINING COST (PER STUDENT $)		10,740		

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

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TABLE 13.
AN/SQQ – 23A PAIR SONAR

NEC	ST-0460
STUDENT THROUGHPUT (PER YEAR)	11
LENGTH OF PROGRAM (DAYS)	288
SCHEDULE (PER YEAR)	2.1
MAJOR TRAINING AREAS (HOURS)	901 LECTURES 600 LABS

NUMBER OF OPERATIONAL UNITS	44
MANNING AUTHORIZATION	4

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	2	1152 ft^2 LAB 875 ft^2 CLASS	(2) SQQ–23A	
MAJOR COST DRIVERS			SPARE PARTS	
COST BREAKOUT (PER STUDENT $)	9870	1020*	2947	
O&MN (PER STUDENT $)			2231	
TOTAL TRAINING COST (PER STUDENT $)			$\boxed{22,100}$	

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

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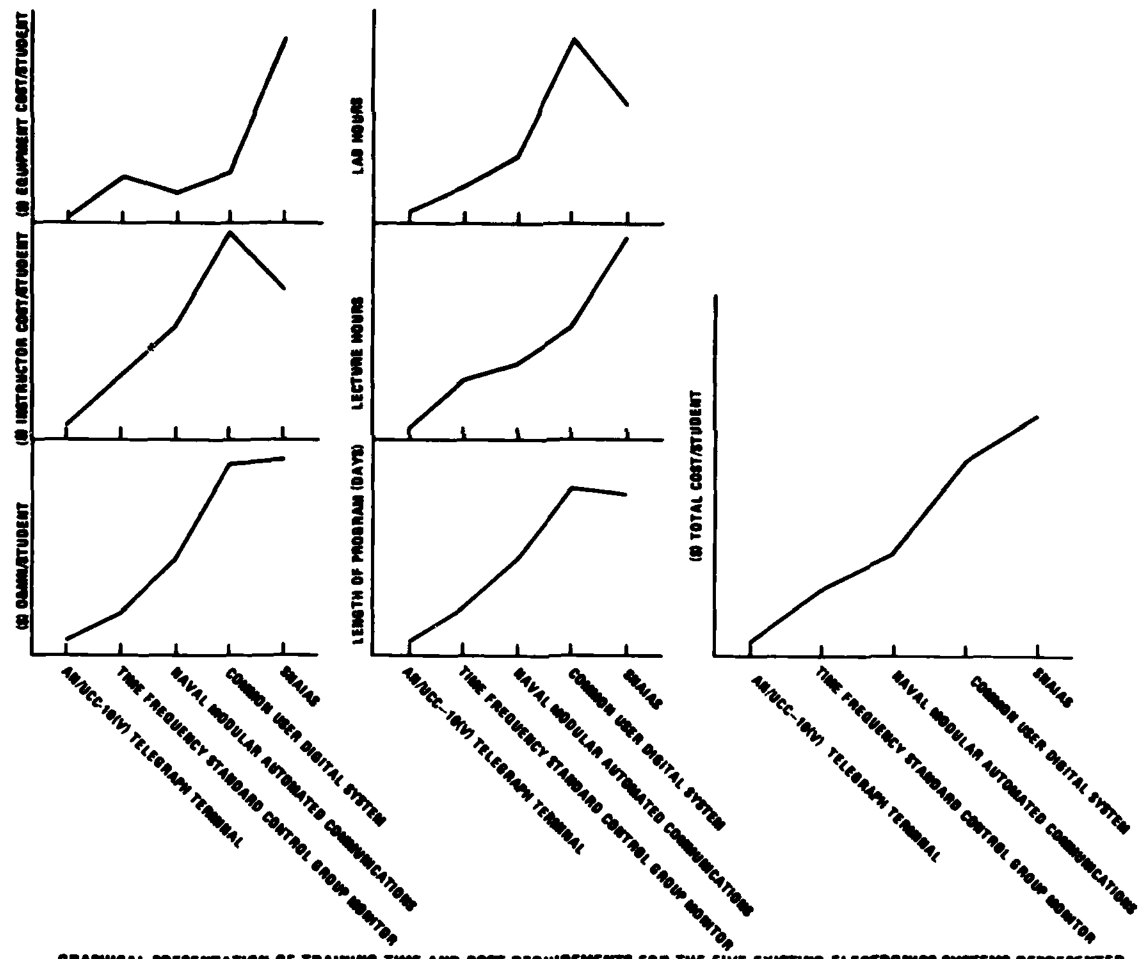

GRAPHICAL PRESENTATION OF TRAINING TIME AND COST REQUIREMENTS FOR THE FIVE <u>EXISTING ELECTRONICS SYSTEMS</u> REPRESENTED ON THE FOLLOWING PAGES. THESE FACTORS ARE RELATED TO SYSTEM COMPLEXITY.

DATA CATEGORIES

NEC--Primary Navy Enlisted Classification associated with the system

Student Throughput (Per Year)--Average number of students graduated each year

Length of Program (Days)--Average time required to complete the course

Schedule (Per Year)--Average number of courses completed each year

Major Training Areas (Hours)--Total number of lecture and laboratory hours required (50 minute periods

Number of Operational Units--Total number of units presently in the field

Manning Authorization--Total number of personnel assigned to each operational unit

Instructor Demands--Estimate of the number of instructors required. To account for variations in course scheduling and student/instructor ratios, this estimate reflects a midpoint between the minimum and maximum number of instructors necessary for training.

Facility Demands--Building construction, modification or space required to adequately house training equipment, etc.

Equipment Demands--Amount and type of hardware or test equipment required for training

Software Demands--Qualitative description of any special software needs

Major Cost Drivers--Qualitative description of salient operating cost factors

Equipment Costs (Per Student $)--Cost of training equipment and devices computed per student. This figure is based on a 10 year life span, 10% salvage value, straight line depreciation schedule for all items over $1,000.

Instructor Costs (Per Student $)--Cost of instructors computed per student. This figure represents pay of all military and travel costs.

O&MN (Per Student $)--Operations and Maintenance, Navy costs for each student. O&MN costs are administrative and overhead costs indirectly involved in training, such as support and organizational personnel, facility operations, maintenance and security, etc.

Total Training Cost (Per Student $)--Total cost for one student to complete the training course

TABLE 14.
AN/UCC–10(V) TELEGRAPH TERMINAL

NEC	ET–1422
STUDENT THROUGHPUT (PER YEAR)	12
LENGTH OF PROGRAM (DAYS)	16
SCHEDULE (PER YEAR)	9
MAJOR TRAINING AREAS (HOURS)	26 LECTURES 52 LABS

NUMBER OF OPERATIONAL UNITS	35 SHIPS, 1 EQUIP/SHIP
MANNING AUTHORIZATION	–

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS MAJOR COST DRIVERS	1	MINIMAL	AN–UCC–10(V)	
COST BREAKOUT (PER STUDENT $)	981	7*	218	
O&MN (PER STUDENT $)		220		
TOTAL TRAINING COST (PER STUDENT $)		1486		

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

.E 15.
RQ-26(MOD) TIME FREQUENCY STANDARD
I890/SRC (MOD) CONTROL GROUP MONITOR

NEC	ET-1464
STUDENT THROUGHPUT (PER YEAR)	34
LENGTH OF PROGRAM (DAYS)	54
SCHEDULE (PER YEAR)	5.2
MAJOR TRAINING AREAS (HOURS)	188 LECTURES 152 LABS

IBER OF OPERATIONAL UNITS	35 SHIPS, 2 EQUIP/SHIP
INING AUTHORIZATION	–

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
IANDS	3	MINIMAL	AN/URQ-26(MOD) OA-8890/SRC	
IOR COST DRIVERS				
IT BREAKOUT (PER STUDENT $)	2183	34*	2186	
IAN (PER STUDENT $)			577	
TAL TRAINING COST R STUDENT $)			5707	

HIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

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TABLE 16.
NAVAL MODULAR AUTOMATED COMMUNICATIONS
SYSTEM A+ (NAVMACS A+)

NEC	ET–1463
STUDENT THROUGHPUT (PER YEAR)	58
LENGTH OF PROGRAM (DAYS)	103
SCHEDULE (PER YEAR)	5.7
MAJOR TRAINING AREAS (HOURS)	208 LECTURES 276 LABS

NUMBER OF OPERATIONAL UNITS	512
MANNING AUTHORIZATION	2

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	3	MINIMAL	AN/UYK–20 AN/WSC–3 OE–82	
MAJOR COST DRIVERS				
COST BREAKOUT (PER STUDENT $)	3690	40*	1323	
O&MN (PER STUDENT $)		1304		
TOTAL TRAINING COST (PER STUDENT $)		9750		

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

TABLE 17.
COMMON USER DIGITAL INFORMATION SYSTEM (CUDIXS)
USQ–64(V) 2 AND USQ–64(V) 1 WSC–5, FSM

NEC	ET-1466
STUDENT THROUGHPUT (PER YEAR)	12
LENGTH OF PROGRAM (DAYS)	187
SCHEDULE (PER YEAR)	3.2
MAJOR TRAINING AREAS (HOURS)	300 LECTURES 772 LABS

NUMBER OF OPERATIONAL UNITS	5
MANNING AUTHORIZATION	4

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	2			
MAJOR COST DRIVERS		MINIMAL	CUDIXS	
COST BREAKOUT (PER STUDENT $)	8006	85*	2231	
O&MN (PER STUDENT $)			2687	
TOTAL TRAINING COST (PER STUDENT $)			13,009	

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM

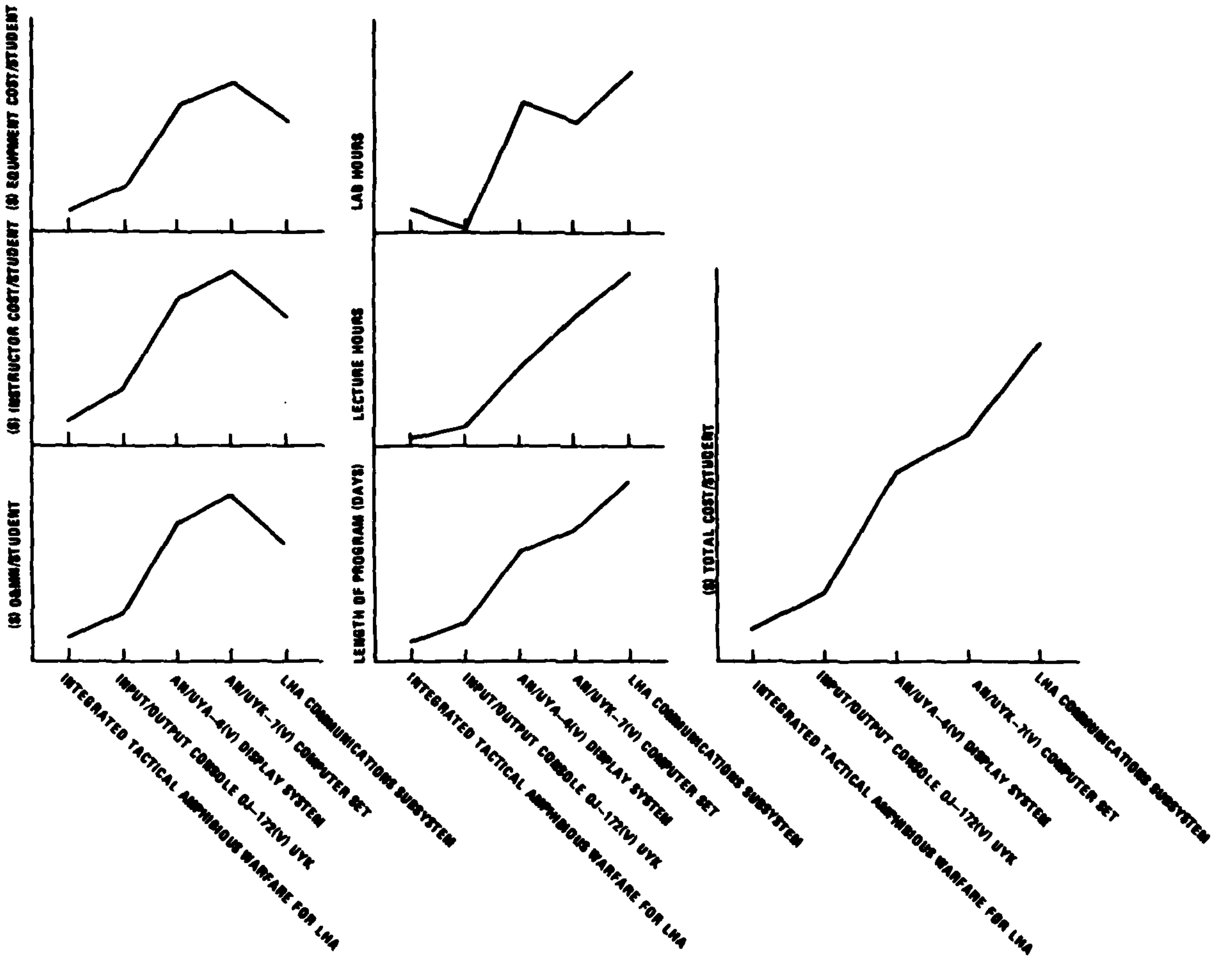
TABLE 18.
SHIPS NAVIGATION AND AIRCRAFT INERTIAL ALIGNMENT SYSTEM (SNAIAS)

NEC	ET-1477
STUDENT THROUGHPUT (PER YEAR)	28
LENGTH OF PROGRAM (DAYS)	180
SCHEDULE (PER YEAR)	3.3
MAJOR TRAINING AREAS (HOURS)	544 LECTURES 404 LABS

NUMBER OF OPERATIONAL UNITS	14
MANNING AUTHORIZATION	4

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	2	MINIMAL	SINS MK-3 MOD 7, AN/SRC-40, VARO POWER SUPPLY, SNAIAS SYSTEM, SPECIAL PURPOSE TEST EQUIPMENT	
MAJOR COST DRIVERS				
COST BREAKOUT (PER STUDENT $)	4023	107*	8378	
O&MN (PER STUDENT $)		2743		
TOTAL TRAINING COST (PER STUDENT $)		21,524		

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM



GRAPHICAL PRESENTATION OF TRAINING TIME AND COST REQUIREMENTS FOR THE FIVE EXISTING DATA SYSTEMS REPRESENTED ON THE FOLLOWING PAGES. THESE FACTORS ARE RELATED TO SYSTEM COMPLEXITY.

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DATA CATEGORIES

NEC--Primary Navy Enlisted Classification associated with the system

Student Throughput (Per Year)--Average number of students graduated each year

Length of Program (Days)--Average time required to complete the course

Schedule (Per Year)--Average number of courses completed each year

Major Training Areas (Hours)--Total number of lecture and laboratory hours required (50 minute periods)

Number of Operational Units--Total number of units presently in the field

Manning Authorization--Total number of personnel assigned to each operational unit

Instructor Demands--Estimate of the number of instructors required. To account for variations in course scheduling and student/instructor ratios, this estimate reflects a midpoint between the minimum and maximum number of instructors necessary for training.

Facility Demands--Building construction, modification or space required to adequately house training equipment, etc.

Equipment Demands--Amount and type of hardware or test equipment required for training

Software Demands--Qualitative description of any special software needs

Major Cost Drivers--Qualitative description of salient operating cost factors

Equipment Costs (Per Student $)--Cost of training equipment and devices computed per student. This figure is based on a 10 year life span, 10% salvage value, straight line depreciation schedule for all items over $1,000.

Instructor Costs (Per Student $)--Cost of instructors computed per student. This figure represents pay of all military and travel costs.

O&MN (Per Student $)--Operations and Maintenance, Navy costs for each student. O&MN costs are administrative and overhead costs indirectly involved in training, such as support and organizational personnel, facility operations, maintenance and security, etc.

Total Training Cost (Per Student $)--Total cost for one student to complete the training course

TABLE 19.
INTEGRATED TACTICAL AMPHIBIOUS WARFARE DATA SYSTEMS FOR LHA

NEC	DS-1674
STUDENT THROUGHPUT (PER YEAR)	8
LENGTH OF PROGRAM (DAYS)	26
SCHEDULE (PER YEAR)	12.0
MAJOR TRAINING AREAS (HOURS)	56 LECTURES 83 LABS

NUMBER OF OPERATIONAL UNITS	5
MANNING AUTHORIZATION	7

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	1		ITAWDS	
MAJOR COST DRIVERS				
COST BREAKOUT (PER STUDENT $)	757	463*	1200	
O&MN (PER STUDENT $)		422		
TOTAL TRAINING COST (PER STUDENT $)		3311		

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

TABLE 20.
INPUT/OUTPUT CONSOLE OJ–172(V) UYK

NEC	DS 1637
STUDENT THROUGHPUT (PER YEAR)	1
LENGTH OF PROGRAM (DAYS)	54
SCHEDULE (PER YEAR)	5
MAJOR TRAINING AREAS (HOURS)	78 LECTURES 31 LABS

NUMBER OF OPERATIONAL UNITS	35 SHIPS, 4 EQUIP/SHIP
MANNING AUTHORIZATION	–

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS MAJOR COST DRIVERS	1		OJ–172(V)	
COST BREAKOUT (PER STUDENT $)	1616	927*	2576	
O&MN (PER STUDENT $)			904	
TOTAL TRAINING COST (PER STUDENT $)			6023	

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

TABLE 21.
AN/UYA – 4(V) DISPLAY SUBSYSTEM

NEC	DS–1066
STUDENT THROUGHPUT (PER YEAR)	27
LENGTH OF PROGRAM (DAYS)	152
SCHEDULE (PER YEAR)	1.5
MAJOR TRAINING AREAS (HOURS)	345 LECTURES 535 LABS

NUMBER OF OPERATIONAL UNITS	–
MANNING AUTHORIZATION	–

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	4			
MAJOR COST DRIVERS			AN/UYA–4(V)	
COST BREAKOUT (PER STUDENT $)	4165	2640*	7000	
O&MN (PER STUDENT $)		2321		
TOTAL TRAINING COST (PER STUDENT $)		10,212		

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

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TABLE 22.
AN/UYK – 7(V) COMPUTER SET (4 BAY SYSTEM)

NEC	DS-1667
STUDENT THROUGHPUT (PER YEAR)	23
LENGTH OF PROGRAM (DAYS)	180
SCHEDULE (PER YEAR)	.9
MAJOR TRAINING AREAS (HOURS)	535 LECTURES 467 LABS

NUMBER OF OPERATIONAL UNITS	36 SHIPS, 1 EQUIP/SHIP
MANNING AUTHORIZATION	–

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	5		AN/UYK-7(V)	
MAJOR COST DRIVERS				
COST BREAKOUT (PER STUDENT $)	4023	3013*	8378	
O&MN (PER STUDENT $)		2743		
TOTAL TRAINING COST (PER STUDENT $)		$\boxed{21,524}$		

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

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TABLE 23.
LHA COMMUNICATIONS SUBSYSTEM

NEC	03–1673
STUDENT THROUGHPUT (PER YEAR)	–
LENGTH OF PROGRAM (DAYS)	250
SCHEDULE (PER YEAR)	–
MAJOR TRAINING AREAS (HOURS)	730 LECTURES 671 LABS

NUMBER OF OPERATIONAL UNITS	5
MANNING AUTHORIZATION	5

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS				
MAJOR COST DRIVERS			LHA COMM SYSTEM	
COST BREAKOUT (PER STUDENT $)	3907	4172*	8122	
O&MN (PER STUDENT $)			2904	
TOTAL TRAINING COST (PER STUDENT $)			20,801	

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

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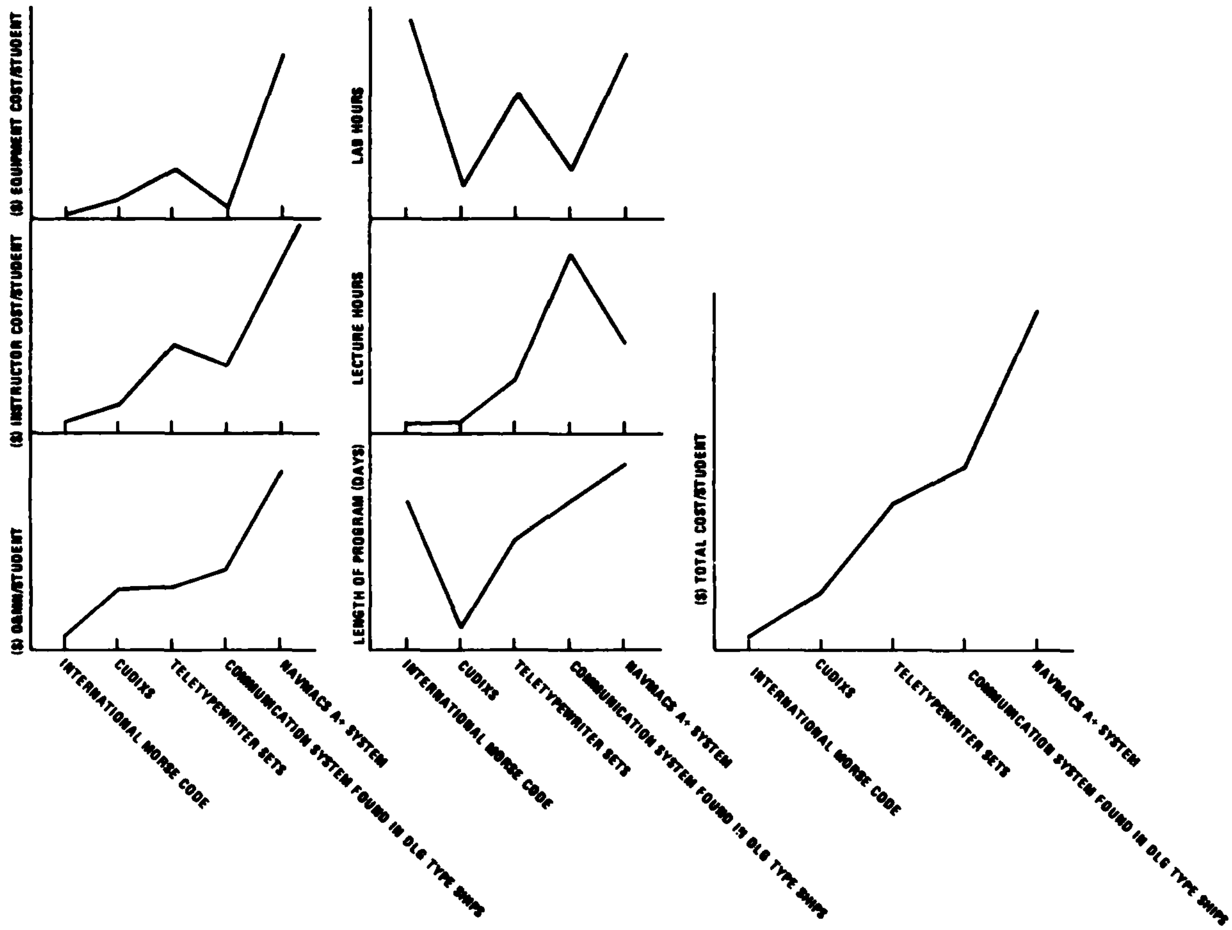

GRAPHICAL PRESENTATION OF TRAINING TIME AND COST REQUIREMENTS FOR THE FIVE EXISTING RADIO SYSTEMS REPRESENTED ON THE FOLLOWING PAGES. THESE FACTORS ARE RELATED TO SYSTEM COMPLEXITY.

DATA CATEGORIES

NEC--Primary Navy Enlisted Classification associated with the system

Student Throughput (Per Year)--Average number of students graduated each year

Length of Program (Days)--Average time required to complete the course

Schedule (Per Year)--Average number of courses completed each year

Major Training Areas (Hours)--Total number of lecture and laboratory hours required (50 minute periods)

Number of Operational Units--Total number of units presently in the field

Manning Authorization--Total number of personnel assigned to each operational unit

Instructor Demands--Estimate of the number of instructors required. To account for variations in course scheduling and student/instructor ratios, this estimate reflects a midpoint between the minimum and maximum number of instructors necessary for training.

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Equipment Demands--Amount and type of hardware or test equipment required for training

Software Demands--Qualitative description of any special software needs

Major Cost Drivers--Qualitative description of salient operating cost factors

Equipment Costs (Per Student $)--Cost of training equipment and devices computed per student. This figure is based on a 10 year life span, 10% salvage value, straight line depreciation schedule for all items over $1,000.

Instructor Costs (Per Student $)--Cost of instructors computed per student. This figure represents pay of all military and travel costs.

O&MN (Per Student $)--Operations and Maintenance, Navy costs for each student. O&MN costs are administrative and overhead costs indirectly involved in training, such as support and organizational personnel, facility operations, maintenance and security, etc.

Total Training Cost (Per Student $)--Total cost for one student to complete the training course

TABLE 24.
INTERNATIONAL MORSE CODE

NEC	RM-2304
STUDENT THROUGHPUT (PER YEAR)	110
LENGTH OF PROGRAM (DAYS)	82
SCHEDULE (PER YEAR)	4.2
MAJOR TRAINING AREAS (HOURS)	18 LECTURES 342 LABS

NUMBER OF OPERATIONAL UNITS	-
MANNING AUTHORIZATION	-

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	4			
MAJOR COST DRIVERS			LHA COMM SYSTEM	
COST BREAKOUT (PER STUDENT $)	208		3	

O&MN (PER STUDENT $)	110
TOTAL TRAINING COST (PER STUDENT $)	920

ABLE 25.
DIXS

NEC	RM-2366
STUDENT THROUGHPUT (PER YEAR)	17
LENGTH OF PROGRAM (DAYS)	12
SCHEDULE (PER YEAR)	24.3
MAJOR TRAINING AREAS (HOURS)	26 LECTURES 54 LABS

NUMBER OF OPERATIONAL UNITS	5
MANNING AUTHORIZATION	8

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	1			
MAJOR COST DRIVERS			CUDIXS	
COST BREAKOUT (PER STUDENT $)	587	86*	156	

O&MN (PER STUDENT $)	587
TOTAL TRAINING COST (PER STUDENT $)	1676

* THIS IS AN ESTIMATE BASED ON TYPICAL REQUIREMENTS FOR THIS KIND OF SYSTEM.

TABLE 26.
TELETYPEWRITER SETS AN/UGC-48A, AN/UGC-49, AN/UGC-47

NEC	RM-2342
STUDENT THROUGHPUT (PER YEAR)	42
LENGTH OF PROGRAM (DAYS)	61
SCHEDULE (PER YEAR)	5.8
MAJOR TRAINING AREAS (HOURS)	120 LECTURES 204 LABS

NUMBER OF OPERATIONAL UNITS	35 SHIP, 8 EQUIP/SHIP
MANNING AUTHORIZATION	–

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	1			
MAJOR COST DRIVERS			AN/UGC-47, 48A, 49	
COST BREAKOUT (PER STUDENT $)	1506		415	
O&MN (PER STUDENT $)		523		
TOTAL TRAINING COST (PER STUDENT $)		4000		

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TABLE 27.

COMMUNICATION SYSTEM FOUND IN DLG TYPE SHIPS

NEC	RM–2313
STUDENT THROUGHPUT (PER YEAR)	419
LENGTH OF PROGRAM (DAYS)	82
SCHEDULE (PER YEAR)	2.8
MAJOR TRAINING AREAS (HOURS)	400 LECTURES 80 LABS

NUMBER OF OPERATIONAL UNITS	45
MANNING AUTHORIZATION	1

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	19		NONE	
MAJOR COST DRIVERS				
COST BREAKOUT (PER STUDENT $)	1131		60	
O&MN (PER STUDENT $)			804	
TOTAL TRAINING COST (PER STUDENT $)			5000	

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TABLE 28.
NAVMACS A+ SYSTEM

NEC	RM-2351
STUDENT THROUGHPUT (PER YEAR)	56
LENGTH OF PROGRAM (DAYS)	103
SCHEDULE (PER YEAR)	2.9
MAJOR TRAINING AREAS (HOURS)	200 LECTURES 276 LABS

NUMBER OF OPERATIONAL UNITS	512
MANNING AUTHORIZATION	2

	INSTRUCTORS	FACILITIES	EQUIPMENT	SOFTWARE
DEMANDS	5			
MAJOR COST DRIVERS			NAVMACS +A	
COST BREAKOUT (PER STUDENT $)	3667		1358	
O&MN (PER STUDENT $)		1452		
TOTAL TRAINING COST (PER STUDENT $)		9410		

TABLE 29. EXAMPLE OF THE USE OF TABLE 3

Name of Existing System Being Compared: EXAMPLE

Design Concepts and Characteristics	New (N)	Existing (E)	Common (C)
1. Repair of Modules	●		
2. Throwaway Modules		●	
3. Automatic Performance Monitoring	●	●	●
4. Built-In Test Equipment (BITE)	●	●	●
5. Built-In Troubleshooting Logic Aids	●	●	●
6. Automatic Fault Localization	●	●	●
7. Manual Troubleshooting			
8. Standard Hardware (Component, Card, Functional Unit)	●	●	●
9. Standard Hardware (Subsystem)	●	●	●
10. Built-In Operator Job Aids	●	●	●
11. Automatic Decision Making		●	
12. Automation Information Transmit and Display	●	●	●
13. Built-In (Embedded) Training			
14. Combined Operator/Maintainer Functions			
15. Multipurpose Equipment		●	
16. Single Purpose Equipment			
17. Manual Control		●	
18. Automatic Control	●		
19. Quantitative Controls/Displays	●		
20. Go/No Go Controls/Displays			
21. Dynamic Interaction of Controls/Displays			
22. Independence of Controls/Displays			
23. Fixed Sequence of Operation	●	●	●
24. Nonprocedural Operational Flexibility			
25. Troubleshoot to Component Level			
26. Troubleshoot to Module Level			
27. Special Purpose Test Equipment	●	●	●
28. General Purpose Test Equipment			
29. On-Site Maintenance & Calibration		●	
30. Off-Site Maintenance & Calibration			
	13	15	10
	Total Ns	Total Es	Total Cs

$$S = \frac{(\text{Total Cs})}{(\text{Total Ns}) + (\text{Total Es}) - (\text{Total Cs})}$$

$$S = \frac{(\ 10\ )}{(\ 13\ ) + (\ 15\ ) - (\ 10\ )} = \boxed{.56}$$

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design concept or characteristic included in the candidate system. For the sake of this example, this resulted in check marks in rows 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 15, 17, 23, 27, and 29 of the "existing (E)" column of Table 3 (see Table 29).

- The user would then place a check mark in the "common (C)" column each time a check appeared in both the "new (N)" and "existing (E)" column for a given design concept. Next, the user would count the number of check marks in each of the three columns and enter the totals at the bottom of Table 3 (see Table 29). For the present example, the totals are "new (N)" = 13, "existing (E)" = 15, and "common (C)" = 10.

- The user would compute an index of similarity (S) by placing the three totals in the following formula:

$$S = \frac{\text{Total Cs}}{(\text{Total Ns}) + (\text{Total Es}) - (\text{Total Cs})}$$

that is,

$$S = \frac{10}{13 + 15 - 10} = .56$$

- This value would be written in the box provided in Table 3 (see Table 29).

- The user would repeat the above procedure for the second candidate existing system (e.g., TARTAR MK 74 MOD4). Suppose this resulted in an index of similarity (S) = .42.

- Comparing the index of similarity (S) = .56 for the first candidate existing system with the index of similarity (S) = .42 for the second candidate existing system, the user would select the first candidate existing system as the one most similar to the new system since its index of similarity (S) was larger than that of the second system. However, if other considerations (e.g., detailed knowledge of a more similar system) warrant, the user may have reason to select another alternative as the most similar.

STEP 2

Determine requirements and costs for existing system.

- Having identified the most similar existing system, the user obtains for this system the relevant resource and cost information which will be used as a basis for estimates of training resource requirements and costs for the new radar. For example, if the AN/SPS-52B radar were identified as the most similar existing system, the user would obtain training resource and cost information from Table 8.

SECTION III

SPECIFICATION OF TRAINING REQUIREMENTS FOR SPECIAL TASKS THAT WOULD REQUIRE HANDS-ON TRAINING RESOURCES

Figure 4 illustrates the contextual and procedural flow of this section.

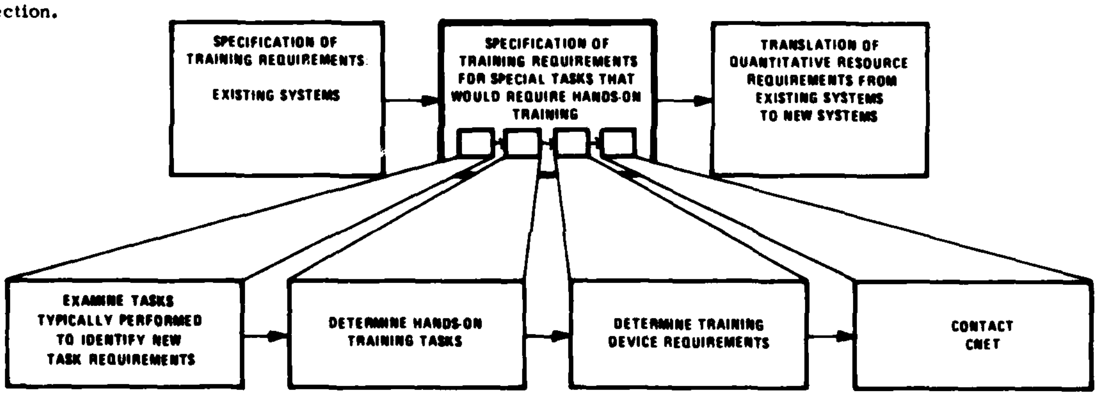

Figure 4. Context and Procedures in Section III

REASON FOR THIS SECTION

After an initial estimate of training resource requirements and costs has been obtained, based on similar existing systems (SECTION II), an identification of different or unique aspects of the new system is critical--especially those which will have a major impact on training resource requirements and costs.

Training equipment and training devices are usually high cost-driver training resource requirements. Furthermore, long lead times are required to plan, program, and budget for those items. Thus it is important to identify as early as possible training equipment/device requirements--particularly those which may be unique to the new system.

Decisions concerning whether or not training equipment or devices are required must be based upon consideration of the tasks to be performed on the new system. Certain tasks require hands-on training while others do not. Requirements for training equipment or devices should be made only for those specific tasks which require hands-on training separately from the operational situation.

Table 30 presents questions to be answered in this section, reasons for answering each question, an indication of how each question is to be answered, and the nature of the answer to each.

WHAT IS TO BE DONE IN THIS SECTION

First, examine the kinds of tasks typically performed by personnel in the rating under consideration (e.g., ET, Electronics Technician). Identify new task requirements.

Second, determine whether there are any special tasks for the new system which require hands-on training.

Third, determine whether training equipment or training devices are required for the new system.

Fourth, contact CNET for assistance and referral if training equipment or devices are required for the new system or if there are any questionable tasks.

TABLE 30. QUESTIONS TO BE ANSWERED IN SECTION III

Question	Reason for Question	How to Answer Question	Output
What sorts of tasks, if any, are unique to the new system?	Training equipment/device requirements must be based upon consideration of the types of tasks to be performed on the new system.	Examine lists of typical tasks presented in Tables 31-35 and refer to design concepts and characteristics presented in Tables 3 and 36.	List of unique tasks to be performed on the new system
What kinds of tasks (particularly any special operator or maintenance tasks) to be performed on the new system require hands-on training?	Only those tasks which require hands-on training separately from the operational situation will require training equipment/devices. Unique hands-on training tasks are likely to require training equipment/devices which presently do not exist.	For each task to be performed on the new system, answer the questions as presented in Table 37.	List of unique tasks which will require hands-on training
Must training equipment or devices be used to train personnel to perform those tasks which require hands-on training, or can on-the-job training suffice?	Training equipment/device requirements will have a greater impact on training resource requirements than OJT requirements because of costs and long lead times.	For each task which requires hands-on training, answer the questions presented in Table 38.	List of unique tasks which require some type of training device or equipment
Can the impact of training equipment/device requirements for the new system be defined?	Existing training devices may be suitable for use on the new system. Recommendations should be obtained concerning development of new devices, associated costs, etc.	Contact CNET for assistance and/or referral concerning the questions presented in Table 40.	Further refinement of training equipment requirements

Examine typical tasks to identify new tasks → Determine hands-on training tasks → Determine training device requirements → Contact CNET

HOW THIS IS TO BE DONE

STEP 1

- Examine lists of typical tasks performed by personnel in the new system. Tables 31-35 present lists of typical tasks performed in the FT, DS, ET, RM, and ST ratings. Tasks in the left column of each table require hands-on training while those in the right column do not.
- Use these task examples to help you think of additional, different, or unique tasks to be performed on the new system. In addition, refer to Table 3 which was used previously to compare the similarity of the new system with existing systems. The design concepts and characteristics listed in Table 3 can be used to stimulate further thought concerning tasks which are potentially unique to the new system. Attention should be centered on those concepts and characteristics which differ between the "new (N)" and "existing (E)" systems. That is, concentrate only on rows with a check mark in <u>either</u> the "new(N)" or "existing (E)" column. Note that differences in design concepts and characteristics between the new and existing system imply differences in tasks between the new and existing system.
- To assist in identifying these task differences, examine the design concepts and characteristics identified in Table 3 in light of Table 36. Table 36 indicates the relationship between design concepts and characteristics and task difficulty. For example, a check mark in the "new (N)" column but not in the "existing (E)" column of the "Repair of modules" row of Table 3 would indicate that "Repair of modules" is unique to the new system. Examining the "Repair of Modules" row of Table 36 would reveal that "Repair of Modules" likely increases maintainer task difficulty of the new system relative to the existing system. Given this information, the user should ask himself, "How is it that repair of modules increases task difficulty?"

In attempting to answer this question the reader should be assisted in generating a list of tasks unique to the new system.

STEP 2

- For each unique task to be performed on the new system, determine whether hands-on training will be required by applying the questions presented in Table 37.
- If your answer to any of the questions in Table 37 is "yes," then hands-on training is required. If your answer to all of the questions in Table 37 is "no," then hands-on training is not required.
- Pay close attention to the words and phrases underlined in Table 37 since they are representative of situations and conditions which indicate the need for hands-on training.
- Refer to the sample tasks (Tables 31-35), noting the types of verbs used in the hands-on vs. non-hands-on columns. This may help you answer the questions in Table 37. Note that hands-on task descriptions tend to contain verbs which denote active performance (e.g., "track," "calibrate") while non-hands-on tasks tend to contain verbs which denote passive performance (e.g., "relate," "understand"). Some tasks which might otherwise be thought to require hands-on training may be placed in the "non-hands-on" category if they are basic tasks the student should have already acquired and no additional training is deemed necessary.

STEP 3

- For those tasks that require hands-on training, determine whether training devices are required by applying the questions in Table 38.
- If your answer to any of the questions in Table 38 is "yes," then some type of training equipment or device is required. If your answer to all of the questions in Table 38 is "no," on-the-job training can be considered to meet the hands-on training requirements.

STEP 4

- If some tasks to be performed on the new system require training equipment or devices.

(Text continued on p. 93)

TABLE 31. SAMPLE TASKS FOR FIRE CONTROL TECHNICIAN RATING

Require "hands-on" training	Do not require "hands-on" training
Acquire/track radar beacon signals	Analyze/annotate system test data
Initiate electronic counter-countermeasures (ECCM) action from aural analysis	Analyze front panel indications for fault detection
Use test equipment to inject signals and/or take readings	Identify standard electronic/mechanical symbols as used on schematics, logic diagrams, flow charts, etc.
Localize/isolate radar power supply malfunction to the module/card level	Research technical publications to find appropriate schematics, logic diagrams, tables, trouble shooting charts, maintenance information, port numbers for specific pieces of equipment

TABLE 32. SAMPLE TASKS FOR SONAR TECHNICIAN RATING

Require "hands-on" training	Do not require "hands-on" training
Track more than one target simultaneously	Remove/replace AF amplifier modules/cards
Localize/isolate equipment malfunction to a unit	Select optimum operating modes in view of SVP and other environmental factors
Calibrate/align/adjust AF amplifier	Relate information from all available sources in classifying target
Detect and identify target maneuvers	Interpret the sound velocity profile and understand its operational implications
Conduct active search using all controls optimally	
Use controls to maintain contact despite O. S. or target maneuvers	

TABLE 33. SAMPLE TASKS FOR RADIOMAN RATING

Require "hands-on" training	Do not require "hands-on" training
Use test equipment to inject signals and/or take readings	Analyze equipment front panel indicators for fault detection
Localize/isolate equipment malfunction to a subsystem	Clean miscellaneous radio equipment
Tune and adjust system components for optimum performance	Remove/replace antenna components
Transmit and receive messages on teletype	Set up URA-17 converter
	Energize system components
	Recognize/understand effects of equipment malfunction

TABLE 34. SAMPLE TASKS FOR DATA SYSTEM RATING

Require "hands-on" training	Do not require "hands-on" training
Use test equipment to inject signals and/or take readings	Clean/lubricate disk file
Localize/isolate card reader malfunctions to the component level	Remove/replace card reader modules/cards
Calibrate/align/adjust A to D and D to A converters	Analyze equipment front panels for fault detection
Test/inspect cooling chilled water system	Perform power up/down procedures on data processing equipment
	Assemble/repair cables and test leads such as connectors, probes, etc.

TABLE 35. SAMPLE TASKS FOR ELECTRONIC TECHNICIAN RATING

Require "hands-on" training	Do not require "hands-on" training
Use test equipment to inject signals and/or take readings	Analyze equipment front panel indicators for fault detection
Localize/isolate equipment malfunction to a unit	Clean/lubricate communication antenna systems
Calibrate/align/adjust radar antenna/drive system	Remove/replace IFF system components such as switches, resistors, capacitors, etc.
Test/inspect radar transmitters	Align/adjust mechanical linkages and gear trains

TABLE 36. RELATION OF DESIGN CONCEPTS AND CHARACTERISTICS TO PROBABLE TASK DIFFICULTY

Design Concepts and Characteristics	Increases Task Difficulty		Decreases Task Difficulty	
	Operator	Maintainer	Operator	Maintainer
Repair of Modules		●		
Throwaway Modules				●
Automatic Performance Monitoring		●	●	
Built-In Test Equipment (BITE)				●
Built-In Troubleshooting Logic Aids				●
Automatic Fault Localization				●
Manual Troubleshooting		●		
Standard Hardware (Component, Card, Functional Unit)				●
Standard Hardware (Subsystem)			●	●
Built-In Operator Job Aids		●	●	
Automatic Decision Making		●	●	
Automation Information Transmit and Display		●	●	
Built-In (Embedded) Training		●	●	
Combined Operator/Maintainer Functions	●	●		
Multipurpose Equipment	●	●		
Single Purpose Equipment			●	●
Manual Control	●			●
Automatic Control		●	●	
Quantitative Controls/Displays	●			●
Go/No Go Controls/Displays		●	●	
Dynamic Interaction of Controls/Displays	●	●		
Independence of Controls/Displays			●	●
Fixed Sequence of Operation			●	●
Nonprocedural Operational Flexibility	●	●		
Troubleshoot to Component Level		●		
Troubleshoot to Module Level				●
Special Purpose Test Equipment		●		
General Purpose Test Equipment				●
On-Site Maintenance and Calibration		●		
Off-Site Maintenance and Calibration				●

Note: A Blackened Space Indicates the Corresponding Design Concept or Characteristic Probably Has an Effect on Task Difficulty. A White Space Indicates the Design Probably Has No Effect.

TABLE 37. HANDS-ON TRAINING REQUIREMENT ALGORITHM

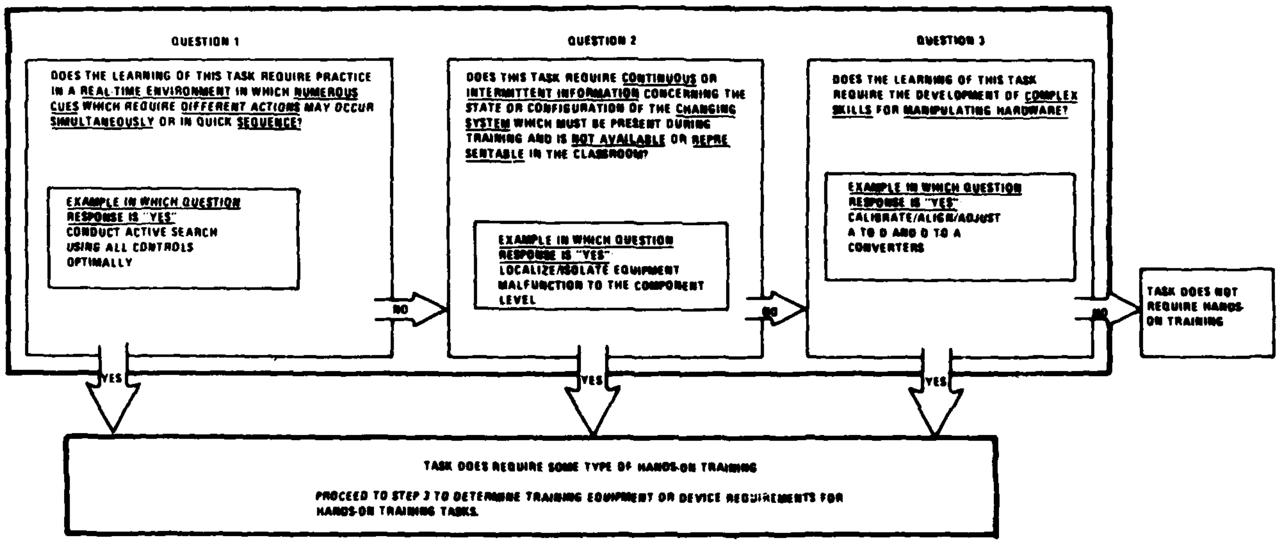

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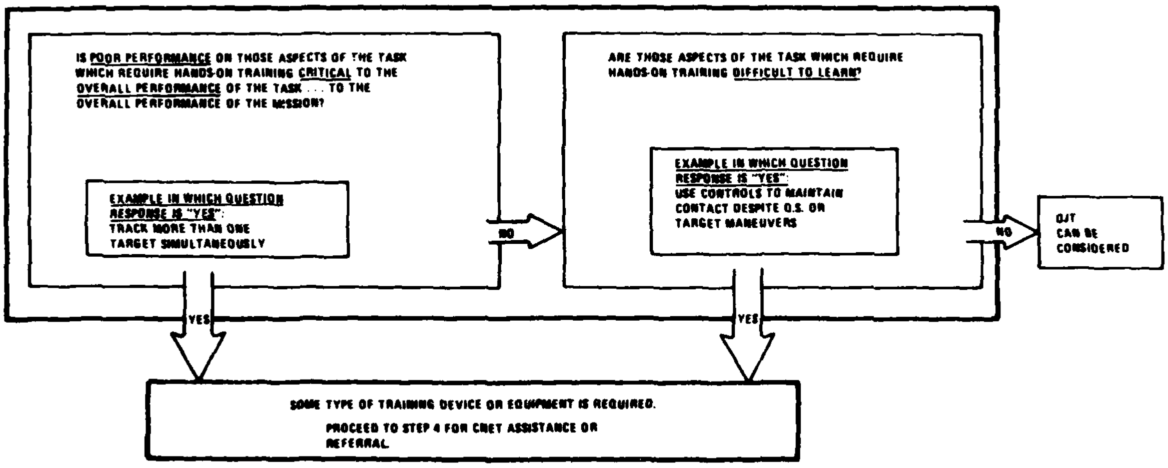
TABLE 38. TRAINING EQUIPMENT OR DEVICE REQUIREMENTS ALGORITHM



or if there are any questionable tasks, contact the Chief of Navy Education and Training (CNET) for assistance and/or referral.

CNET is responsible for assigned shore-based education and training of Navy and other personnel in support of the Fleet, Naval Shore Establishment, Naval Reserve, and interservice and foreign programs. It is supported in these efforts by the Chief of Navy Technical Training (CNTECHTRA) which is responsible for overseeing the individual training centers and schools (functional commands). CNET is further supported by the Navy Training Equipment Center (NTEC) and Instruction Program Development Centers (IPDCs). NTEC is responsible for developing training devices to support specialized technical training. IPDCs are responsible for developing training courses through the application of instructional system development (ISD) procedures. Table 39 describes the role these agencies may serve in assisting the reader. The kinds of questions to raise with CNET and its support agencies are given in Table 40.

EXAMPLE OF HOW THIS SECTION SHOULD BE FOLLOWED

STEP 1

Generate a list of unique tasks to be performed on the new system.

- Assume the new system is an SPS-53 radar for fire control. The user would refer to Table 31 to examine sample tasks associated with the Fire Control Technician rating.
- Upon reviewing the sample tasks associated with the FT rating, the user attempts to identify unique tasks to be performed on the system. For example, "Measure minimum discernible signal" is a task which the user determines is unique to the new system.
- Additionally, the user refers to Table 29 developed in the example to Section II. Concentrating on rows with a check mark in either the "new (N)" or "existing (E)" column, the user observes, for example, that "Repair of Modules" implies differences in tasks between the new and existing system because the new system involves this design concept while the existing system does not.

TABLE 39. DIRECTIONS TO TRAINING ACTIVITY

Agency	Function
Chief of Navy Education & Training (CNET)	• Initial point of contact for training matters • Input to Navy Training Plans (NTPs) • Selection of training data item descriptions (DIDs) • Review of contractor-developed training programs
Chief of Navy Technical Training (CNTECHTRA)	• Resource allocation • Planning, programming, budgeting • Course improvements • Course scheduling
CNET Functional Commands	• Assistance in estimating initial resource requirements -training objectives broadly stated -recommended training locations -facility requirements -instructors -disestablishment of existing courses -quantity of training equipment and devices -need for training equipment and devices
Navy Training Equipment Center (NTEC)	• Specification of training device characteristics -inventory of training devices -use of existing devices for new applications • Trends in training technology • Costs in developing new devices
Instruction Program Development Center (IPDC)	• Instructional System Development (ISD) -task data -skill/knowledge analyses -performance measures -training objectives -media selection -lesson development

TABLE 40. QUESTIONS TO RAISE WITH CNET

Are training equipment or devices currently used for tasks similar to those identified for the new system?
Should training devices rather than operational equipment be used?
What is the cost of required devices?
If new devices must be developed, what development costs are expected?
How many devices or items of training equipment are required for the new system?
Do the identified tasks require any other special consideration?

- The user refers to Table 36 for additional assistance in identifying task differences. The check mark in the "new (N)" column but not in the "existing (E)" column of the "Repair of Modules" row of Table 29 indicates that "Repair of Modules" is unique to the new system Examining the "Repair of Modules" row of Table 36 reveals that repair of modules likely increases maintainer task difficulty of the new system relative to the existing system. The user, asking himself the question, "How is it that repair of modules increases task difficulty?," then generates additional tasks unique to the new system such as "Test and adjust power supply."
- The user continues to identify unique tasks to be performed on the new system until he feels reasonably sure no major tasks have been omitted.

STEP 2

Determine which tasks require hands-on training.

- The user applies the questions in Table 37 to the list of unique tasks generated in Step 1. For example, the user applies the questions in Table 37 to the "Measure minimum discernible signal" task. The user pays close attention to the words and phrases underlined in Table 37 and determines that the learning of this task does require numerous cues to occur simultaneously or in quick sequence (Question 1). The performance of this task, for example, involves responding to cues presented in quick sequence via a wavemeter and power meter. The user therefore concludes that this task will require some type of hands-on training. It should be noted that had the user responded negatively to Question 1, he would have proceeded to Question 2 and then to Question 3, if necessary, to determine if the task requires hands-on training.
- The user is further aided in determining that the "Measure minimum discernible signal" task requires hands-on training by noting that the verb "Measure" of the task description denotes active performance.

- The reader continues to examine each identified task in this fashion, noting which tasks require hands-on training.

STEP 3

Determine which hands-on training tasks require training on equipment/devices.

- The user applies the questions in Table 38 to the tasks identified as requiring hands-on training. For example, the user applies the questions in Table 38 to the "Measure minimum discernible signal" task. The user concludes that although poor performance on this task will not critically compromise mission performance, it is a difficult task to learn. Therefore, some type of training device is required to train this task.
- The reader continues in this fashion for each task requiring hands-on training until all tasks requiring training equipment or devices have been identified.

STEP 4

Further define training equipment requirements.

- The reader then contacts CNET (N-32) to determine suitability of existing training devices, recommendations concerning development of new devices, and associated costs.

SECTION IV

TRANSLATION OF QUANTITATIVE RESOURCE REQUIREMENTS FROM EXISTING SYSTEMS TO NEW SYSTEMS

Figure 5 illustrates the contextual and procedural flow of this section.

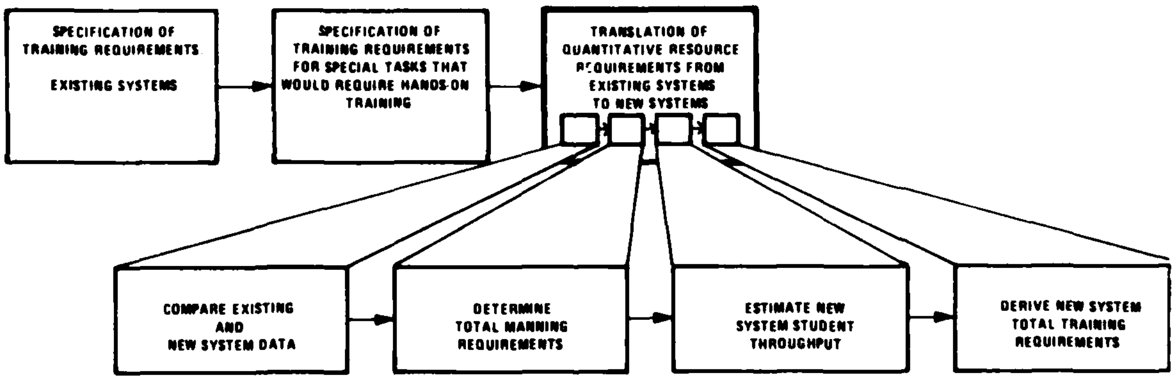


Figure 5. Context and Procedures in Section IV

REASON FOR THIS SECTION

Ultimately, the acquisition planner is interested in the total cost of training for the new system. However, the data obtained in Section II allow determination of the total cost of training for existing systems only. To estimate total training requirements for the new system, differences in manning authorization and number of operational units deployed between the existing system and the new system must be taken into account. The training resource requirements and cost data obtained for a *similar* existing system must be translated for use in estimating training requirements for the new system.

Table 41 presents questions to be answered in this section, reasons for answering each question, an indication of how each question is to be answered, and the nature of the answer to each.

WHAT IS TO BE DONE IN THIS SECTION

First, determine whether manning authorization or number of units deployed differ between the existing similar system and the new system. Second, if either differs, determine total manning requirements for both the existing and new systems. Third, estimate student throughput for the new system. Fourth, convert the existing system values to obtain an estimate of total training resource requirements and costs of the new system.

Compare existing and new system data → Determine total manning requirements → Estimate new student throughput → Derive new system total training requirements

HOW THIS IS TO BE DONE

STEP 1

- Determine manning authorization and number of operational units to be deployed for the new system.
- Compare these to the manning authorization and number of operational units for the similar existing system as obtained from the appropriate table in Section II.

  If there is no expected difference in manning authorization or number of units, the data for the similar system may be used directly to estimate training requirements for the new system.

TABLE 41. QUESTIONS TO BE ANSWERED IN SECTION IV

Question	Reason for Question	How to Answer Question	Output
How can estimates for the new system be obtained from existing similar system data when the new system requires different manning levels or number of deployed units?	Differences in manning authorization or operational units between the new and existing systems will have definite impact on new system total training estimates.	Determine manning authorization and number of operational units for the new system and compare these to data for the similar existing system.	Determination of the necessity to convert existing system demand and cost data before estimating new system requirements
What are the total manning requirements of the new and existing systems?	Total manning for the systems to be compared must be taken into account to obtain a realistic total training estimate for the new system.	Use manning authorization and number of operational units to determine total manning requirements.	Determination of total manning requirements
What is the estimated student throughput for the new system?	Total training requirements cannot be obtained without an estimate of the number of students to be trained on the new system.	Use total manning requirements of the new and existing systems and the existing system student throughput to establish a ratio for determining new system student throughput.	Estimation of new system student throughput
What are the total training resource requirements and costs for the new system?	Estimates of total training demands and costs required for the new system is the ultimate goal of the acquisition planner.	Use the new system student throughput and the demand and cost figures from the similar existing system to determine total training estimates for the new system.	Estimation of total training requirements and costs for the new system

If either manning authorization or number of operational units differs, the data for the *existing system must be converted to estimate* training requirements and costs for the new system. The following steps outline this conversion.

2

Determine total manning requirements for the existing similar system.

Determine total manning requirements for the new system.

ula:

$$\text{Manning rements} = \text{Manning Authorization} \times \text{Number of Operational Units}$$

3

- Estimate student throughput for the new system. The formula below equalizes the student throughput/total manning ratio for the new and existing systems.

Formula:

$$\text{Student Throughput New System} = \text{Total Manning New System} \times \frac{\text{Student Throughput Existing System}}{\text{Total Manning Existing System}}$$

STEP 4

- Estimate total resource requirements and costs for the new system using the student throughput of the new system and per student values for the similar existing system as obtained from the appropriate table in Section II.
  - Equipment, facility, and instructor demands and schedule figures contained in the existing system table must first be converted into per student values in order to estimate these total demand requirements for the new system. Apply the following formula to obtain new system total demand requirements.

Formula:			
New System Total Training Demands	=	$\frac{\text{Demand Value Existing System}}{\text{Student Throughput Existing System}}$	x Student Throughput New System

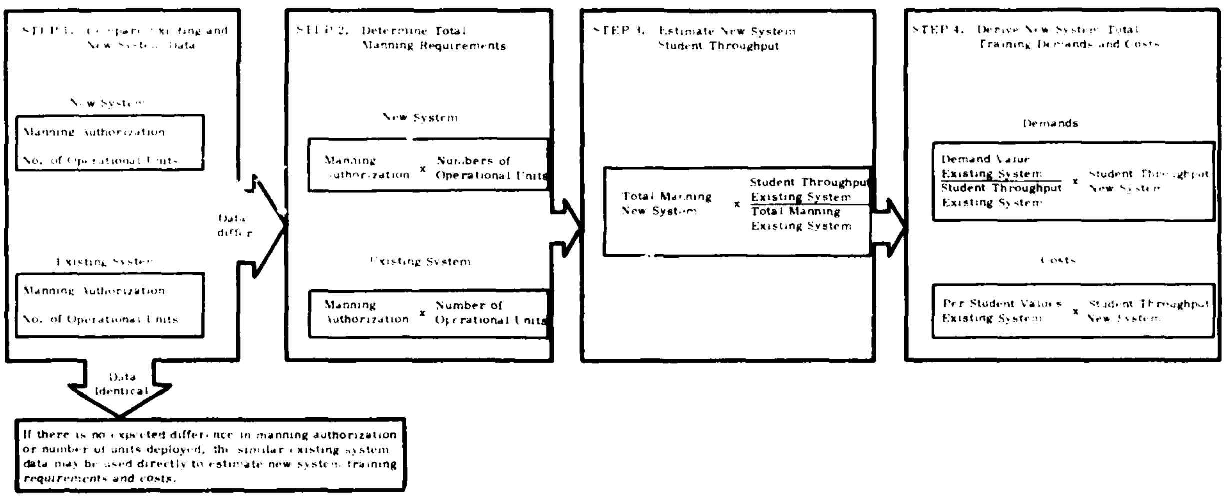
- Total training cost and cost breakout figures contained in existing system tables are already converted to per student values. Apply the following formula to obtain total training costs for the new system.

Formula:				
New System Total Training Costs	=	Per Student Values Existing System	x	Student Throughput New System

- To obtain life-cycle requirements and costs for the new system, simply multiply the total training demands or costs by the number of years the system is expected to be in service (minimum of 10).

Table 42 presents a summary of these procedural steps.

TABLE 42. SUMMARY OF PROCEDURAL STEPS FOR TRANSLATING QUANTITATIVE RESOURCE REQUIREMENTS FROM EXISTING SYSTEMS TO NEW SYSTEMS



Note This formula is applied separately for each of the following: Instructor demands, facility demands, equipment demands, and schedule demands.

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EXAMPLE OF HOW THIS SECTION SHOULD BE FOLLOWED

STEP 1

Compare existing and new system data.

- The user determines that the new system, the SPS-53 Radar, will have a manning authorization of 5 and will have 50 operational units deployed.
- The user compares these values to the values in Table 8 for the 3D Radar System and finds the values differ.
- Because of this difference, the resource demands and costs given in Table 8 for the 3D Radar must be converted in order to estimate total resource demands and costs for the new system.

STEP 2

Determine total manning requirements.

- Total manning for the SPS-53 and 3D Radar systems is computed next:
  - For the 3D Radar:
    Total Manning = 4 x 30 = 120
  - For the SPS-53:
    Total Manning = 5 x 50 = 250

STEP 3

Estimate new system student throughput.

- Student throughput for the SPS-53 is estimated as follows:

$$\text{Student Throughput SPS-53} = 250 \times \frac{23}{120} = 48$$

or

$$\text{Student Throughput SPS-53} = \begin{array}{c}\text{Total}\\ \text{Manning}\\ \text{New}\\ \text{System}\end{array} \times \frac{\text{Student Throughput Existing System}}{\text{Total Manning Existing System}}$$

STEP 4

Derive new system total training requirements.

- In order to obtain total training demand estimates for the SPS-53, the data in the Equipment Demands, Facility Demands, Instructor Demands, and Schedule columns of Table 8 must be converted into per student

values and then multiplied by the student throughput for the SPS-53.

The Instructor Demands for the 3D Radar are listed as 5 in Table 8.

The user would divide the instructor demand for the 3D Radar by the 3D Radar Student Throughput to obtain the per student instructor demand value. This value is then multiplied by the student throughput of the SPS-53 to obtain the total number of instructors required by the SPS-53.

$$\text{Total Instructor Demand SPS-53} = \frac{5}{23} \times 48 = 10.4$$

or

$$\text{Total Instructor Demand SPS-53} = \frac{\text{Demand Value Existing System}}{\text{Student Throughput Existing System}} \times \text{Student Throughput New System}$$

For the sake of example, assume that the Facility Demands for the 3D Radar involve 1200 sq. ft.

$$\text{Total Facility Demand SPS-53} = \frac{1200}{23} \times 48 = 2504.35$$

or

$$\text{Total Facility Demand SPS-53} = \frac{\text{Demand Value Existing System}}{\text{Student Throughput Existing System}} \times \text{Student Throughput New System}$$

The schedule demands for the 3D Radar are listed as 1.77 in Table 8.

$$\text{Total Schedule Demand SPS-53} = \frac{1.77}{23} \times 48 = 3.69$$

or

$$\text{Total Schedule Demand SPS-53} = \frac{\text{Demand Value Existing System}}{\text{Student Throughput Existing System}} \times \text{Student Throughput New System}$$

The equipment demands for the 3D Radar are listed as 2 (one SPS 52B for each of 2 locations) in Table 8. The same logic holds for the Operator Trainer.

$$\text{Total Equipment Demand SPS-53} = \frac{2}{23} \times 48 = 4.17$$

or

$$\text{Total Equipment Demand SPS-53} = \frac{\text{Demand Value Existing System}}{\text{Student Throughput Existing System}} \times \text{Student Throughput New System}$$

- Since total training cost and cost breakout figures contained in Table 8 are already converted to per student values, total training cost estimates for the SPS-53 can be obtained by multiplying these values by the student throughput for the SPS-53.

  For example, the total training cost per student for the 3D Radar is $30,975. To estimate the total costs for yearly student throughput for the SPS-53, the user would compute as follows:

  Total yearly cost ≈ $30,975 x 48 = $1,486,800.

- If the user desires to estimate life cycle costs or requirements, he would assume a life expectancy of 10 years.

  For example, the user would multiply the total training cost for the SPS-53 by 10.

  Total Life Cycle Training Cost =
  $1,486,800 x 10 = $14,868,000

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APPENDIX

DEFINITIONS OF DESIGN CONCEPTS AND CHARACTERISTICS

REPAIR OF MODULES

Modules are removable, plug-in units that contain individual components. When repairing a fault, the faulty unit must be removed from the chassis, repaired on board the ship, and replaced before the equipment can be brought back on line. The training requirements of maintenance personnel are increased.

THROWAWAY MODULES

The faulty module (see above) is removed from the chassis, replaced with a spare, and the equipment is brought back on line. The faulty module is then discarded in accordance with a philosophy of minimizing manning and maintenance facilities. The training requirements of maintenance personnel are decreased.

AUTOMATIC PERFORMANCE MONITORING

This includes hardware and software subsystem monitoring to detect and display conditions of degraded performance. APM will decrease operator training and increase training needs of maintenance personnel.

BUILT-IN TEST EQUIPMENT (BITE)

The connections between built-in displays and test points are achieved through switch selections, eliminating much of the need for separate, independent test equipment. This decreases training requirements for maintenance personnel.

BUILT-IN TROUBLESHOOTING LOGIC AIDS

Computer-based systems are provided with auxiliary software and information displays that guide personnel through preventive maintenance steps and systematic

troubleshooting strategies. The training needs for maintenance personnel are decreased .

AUTOMATIC FAULT LOCALIZATION

An automated subsystem is used to perform measurements at various test points and to deduce the localization of faults to some degree of resolution. Use of this equipment eliminates the need for some separate test equipment and maintenance documentation. Maintenance training requirements are also diminished.

MANUAL TROUBLESHOOTING

System faults are diagnosed by personnel without the use of built-in troubleshooting logic aids or automatic fault localization software programs. Maintenance personnel require more instruction to perform required tasks.

STANDARD HARDWARE (COMPONENT, CARD, FUNCTIONAL UNIT)

Hardware at the component, card (module), and functional unit indenture levels, which is identical to hardware used on other shipboard systems, is selected. Training needs of maintenance personnel are decreased.

STANDARD HARDWARE (SUBSYSTEMS)

Hardware at the subsystem indenture level, which is identical to hardware used on other shipboard systems, is selected. Operator and maintainer training requirements are decreased when this concept is used.

BUILT-IN OPERATOR JOB AIDS

Computer-based systems are provided with auxiliary software to guide the operator through setup sequences and aid him in the acquisition and management of information necessary to perform his tasks. This places an additional burden on the maintainer and requires additional training. Operation is simplified and requires less training.

AUTOMATIC DECISION MAKING

Computer-based systems in which primary responsibility for selecting and integrating information, interpreting it, and making decisions rests with the system software. The operator is primarily a monitor and an arbitrator of indeterminate cases. The maintainer will require additional training, while the operator training requirements are decreased.

AUTOMATION INFORMATION TRANSMIT AND DISPLAY

Functions requiring runners, phone talkers, plotters, etc., are reduced in number through system features that automatically transfer information from one station to another and automatically format it for display. Maintenance training requirements are increased while operator training needs are decreased.

BUILT-IN (EMBEDDED) TRAINING

Computer-based systems are provided with additional software and possibly some hardware to perform shipboard training. The training subsystem would reflect a detailed analysis of onboard training requirements. Operator training requirements are decreased while maintenance training requirements are increased.

COMBINED OPERATOR/MAINTAINER FUNCTIONS

Equipment is both operated and maintained by the same personnel. Training time is increased while personnel requirements are decreased.

MULTIPURPOSE EQUIPMENT

The equipment is highly flexible and performs several functions. Training requirements for both operator and maintainer are increased.

SINGLE PURPOSE EQUIPMENT

The equipment is specially designed for a particular purpose and performs only a single function. Training requirements for the operator and maintainer are decreased.

MANUAL CONTROL

The equipment performs no functions without the operator first initiating a control action. Operator training requirements are increased while maintenance personnel require less training.

AUTOMATIC CONTROL

All functions are performed automatically by the equipment, while the operator merely monitors its performance. Maintainence personnel require more training while operators need less instruction.

QUANTITATIVE CONTROLS/DISPLAYS

This equipment provides information to the technician in the form of quantitative, scale type displays. Operators require additional training to make decisions, while maintenance personnel require less training.

GO/NO-GO CONTROLS/DISPLAYS

This equipment provides information to the technician in go/no-go form. Tasks are simple, discrete, and evaluated on yes/no criteria. Operator training requirements are decreased while maintenance personnel need more training.

DYNAMIC INTERACTION OF CONTROLS/DISPLAYS

Changing the position or configuration of controls causes a corresponding change in displays. Displays monitor the controls. Training requirements are increased for both operators and maintainers.

INDEPENDENCE OF CONTROLS/DISPLAYS

Changing the position or configuration of controls does not cause a change in displays. Training demands for operators and maintainers are decreased.

FIXED SEQUENCE OF OPERATION

Performance of tasks requires only linear sequential procedures. Training demands are decreased for operators and maintainers.

NONPROCEDURAL OPERATIONAL FLEXIBILITY

Tasks may be performed correctly using several (unlimited) procedures. Correct or incorrect performance is hard to determine. Training for both operators and maintainers is increased.

TROUBLESHOOT TO COMPONENT LEVEL

Maintenance personnel troubleshoots the equipment within modules. Training for maintenance personnel is increased.

TROUBLESHOOT TO MODULE LEVEL

Personnel do not enter modules for troubleshooting. May be performed by alternately replacing suspect modules with functional modules ("Easter-egging"). Training needs for maintenance personnel are decreased.

SPECIAL PURPOSE TEST EQUIPMENT

Test equipment designed and used for a single task. Maintenance personnel must be trained in its use, increasing the time spent in training.

GENERAL PURPOSE TEST EQUIPMENT

Test equipment is flexible enough to be used for several tasks. Maintenance personnel require less training time because less time is spent on learning tool use.

ON-SITE MAINTENANCE AND CALIBRATION

Tasks are performed by personnel at the site where equipment is used. Training time for maintenance personnel increases proportionately with task difficulty.

OFF-SITE MAINTENANCE AND CALIBRATION

Required maintenance and calibration is performed by personnel outside of the operational situation. Training needs of maintenance personnel are decreased.

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